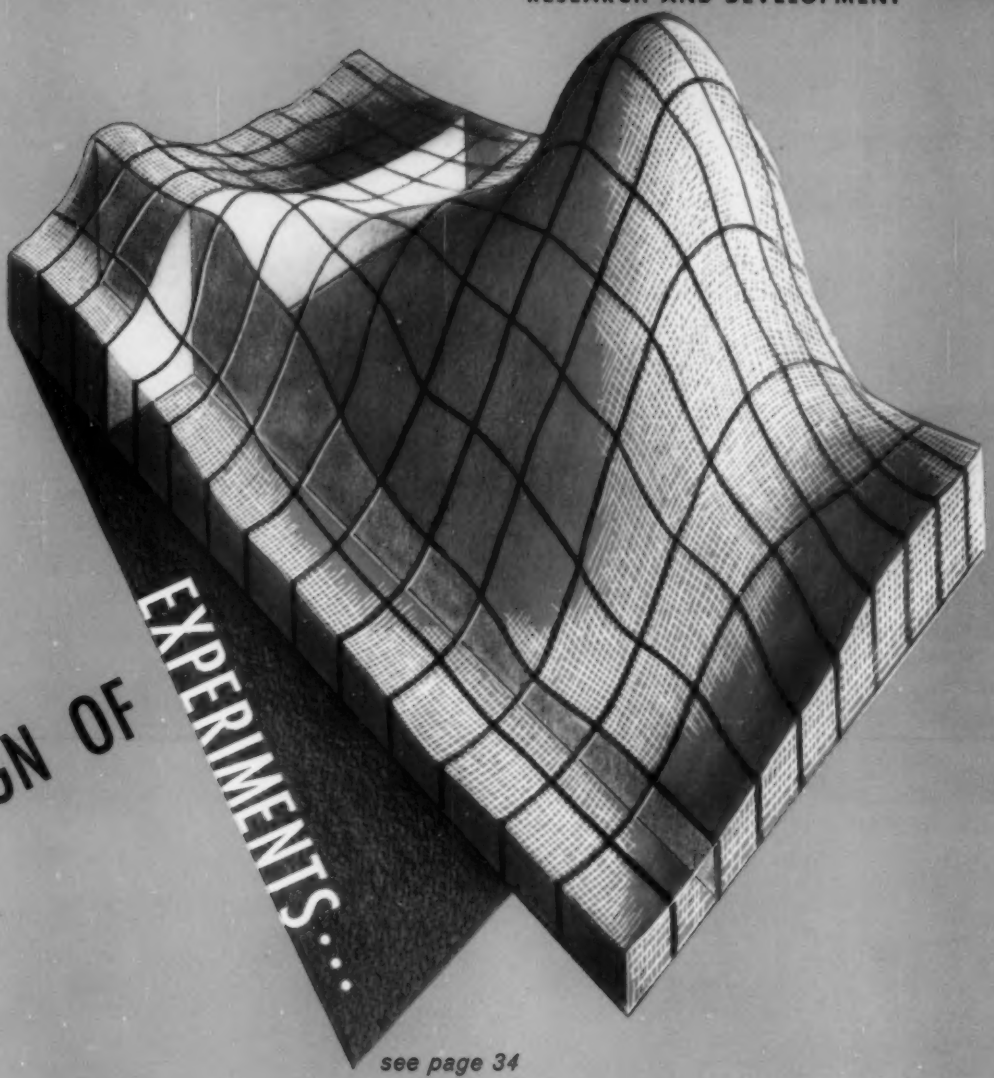
SEPTEMBER 22, 1958 Price 50 cents

RESEARCH and DEVELOPMENT news edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT



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READERS DEBATE:

"the little man can't protect his patents" ...

see page 38

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Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news edition

September 22, 1958 Vol. 29, No. 39

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Product Engineering . . . . SIDELIGHTS

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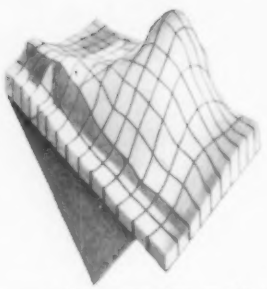

● **Design of experiments** (p 34) is another application of what now amounts to a renaissance of mathematics. With computers to do the heavy work, operations research, statistical analysis, and servo theory have been applied in areas long thought way beyond meaningful analysis. For example, two recent papers promise a deeper understanding of the research, development and manufacturing process than anything we have had to date. In the *IBM Journal of R & D* (July '58) you'll find the start of a method for estimating the man-hours of effort for R & D projects to better than ±15%. And in the *Harvard Business Review* (July-Aug '58) you can read about a mathematical model of a manufacturing company set up by an economist in which a 10% change in consumer buying habits was enough to start factory production swinging through wild oscillations of ±50% or more.

● **Definitions of engineering** vs science (July 28, p 17 and Aug 25, p 4) get simpler and simpler. Last week we came across a beauty by Admiral Hyman Rickover in hearings before the Committee on Astronautics and Space Exploration: "When a scientist makes a mistake, he takes an eraser and erases it; but when an engineer makes a mistake, he has to wear it around his neck where everyone can see it. That is the difference."

● **The patents debate** (p. 38) is spiced by recent reports of the Astron a device for controlling nuclear fusion that may be "economically competitive with conventional power sources." A radically different "magnetic bottle," the Astron was invented by Nicholas C. Christofilos, the same electrical engineer who suggested the principle of the high-energy particle accelerator to University of California scientists back in 1951. Dismissed as a crank letter then, the idea was later developed independently at Brookhaven. The AEC generously acknowledged Mr. Christofilos' priority, paid him $10,000 and enlisted his assistance in the design. He has now been invited to join the staff working on the Astron.

ABP SEPTEMBER 22, 1958 **Product Engineering** *A McGRAW-HILL PUBLICATION* Vol. 29, No. 39 ABC

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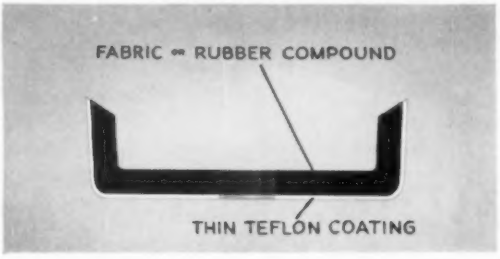

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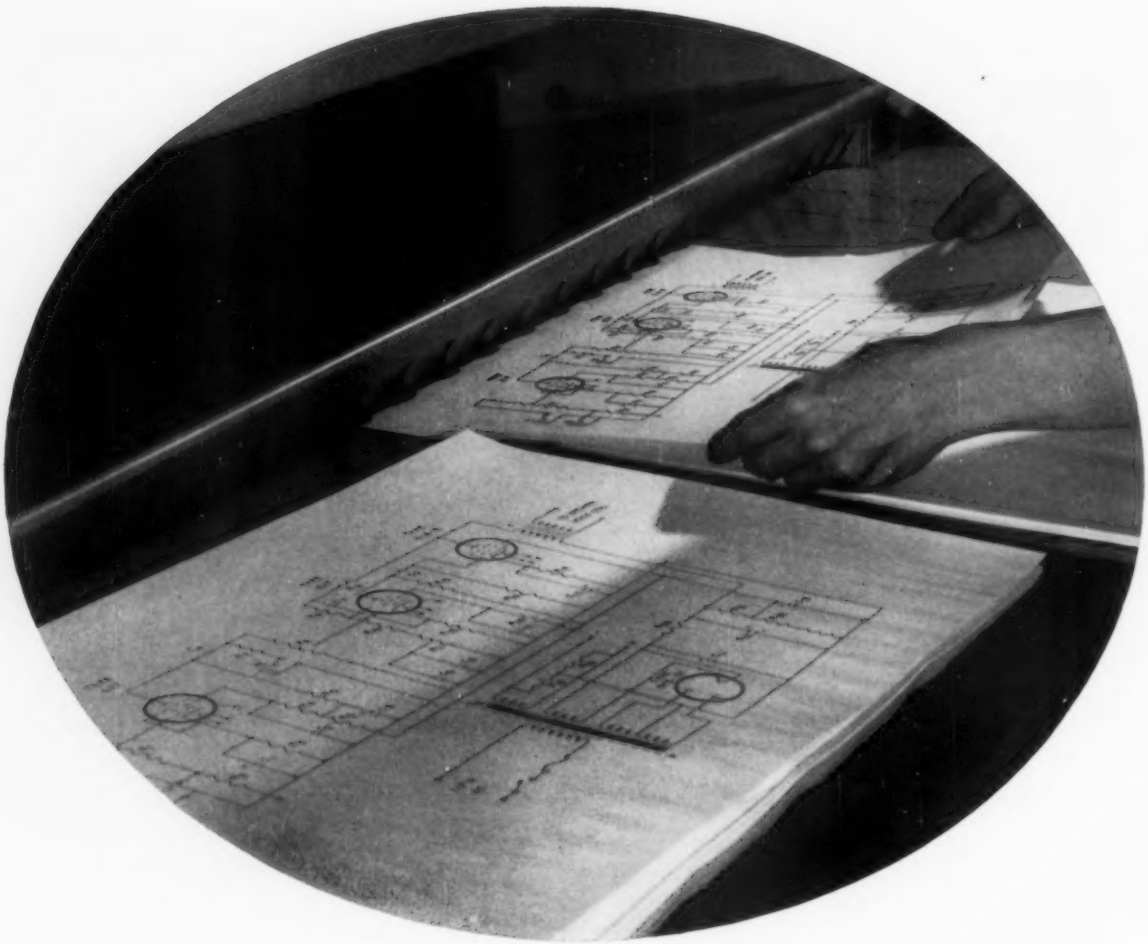

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American... DEVELOPMENTS TO WATCH...

Hydraulic fluids for continuous service . . .

. . . at 550 F, or short-term use to 700 F, have been developed by Dow Corning Corp. These are silicone fluids, said to show promise as a lubricant base as well as for work in closed hydraulic systems. They are still experimental, though, and available in limited quantities only.

Lubricating ability of one new compound, QF-6-7009, is said to be "better than most high-temperature fluids previously available." The compound does not, however, have the low-temperature range associated with some of the others. It freezes at minus 30 F, has a viscosity of 1500 centistokes at 0 F, which drops off to less than unity at 500 F. Spontaneous ignition temperature is 690 F.

New rubbers will resist cracking . . .

. . . even under extreme conditions of heat, ozone, and radiation, Goodyear researchers told the ACS.

Recent tests of "adduct rubbers," highly-saturated polybutadienes, have given outstanding results. For instance, they say, even without anti-ozonants, block-loaded, tread-type stocks withstand exposure to 10,000 ppm ozone for periods of 200 hr or more. Under similar conditions, they reported, butyl and neoprene stocks crack in less than 20 hours.

Bladder-type stocks formulated from the newer materials and suitably vulcanized "appear at least equivalent to resin-cured butyl."

Molybdenum that is workable as-cast . . .

. . . is promised by Oregon Metallurgical Corp, result of recent research on casting techniques for the newer metals, some of which are already at the stage of commercial application (see p 12). Ductile cast molybdenum has not yet been converted to finished parts; but Oremet believes it will permit use of molybdenum for many shapes which are presently either too expensive or far too difficult to produce in this metal—complex heat-resistant components for turbojet engines and rockets; and corrosion-resistant valves, pumps, and other components for petrochemical equipment.

Thermoelectric power-source development . . .

. . . is spotlighted by two experimental devices unveiled this month. One by the Nortronics Div of Northrop Aircraft; the other by RCA. Both units are designed for cooling instruments that must operate at high ambient temperatures, and both take advantage of the temperature differential that is created when an electrical current is imposed on a junction of two dissimilar metals. (For information on other such devices, see *PE—July 14, p 8; Aug 11, p 5*).

Northrop calls its unit a "midget refrigerator," and hopes to use it to cool infrared detector cells, now kept from overheating by liquid nitrogen. The thermoelectric device is tiny enough so that it can be incorporated in the same tube that holds the infrared sensor, will drop temperature as much as 90 F (from an ambient temperature of 70 F to below freezing).

RCA has dubbed its device a "heat pump," pointing up the fact that thermoelectric elements can serve for heating as well as cooling, depending on the direction in which the current flows. Like the Northrop unit, RCA's is on a very small scale, designed for instrument use.

Aging autos and bulging pocketbooks . . .

. . . spark predictions of a good year ahead. Sales of 1958 autos are not expected to be over 4.5 million when final figures are in, and purchases of most appliances are still at below-1957 levels. But personal savings are at a new high, and there is plenty evidence that consumers will fork up the cash if offered products they like. At the same time, the fact that auto sales have been "depressed" since 1955 means that only a very small fraction of the cars now on the road are less than 3 years old—a fact pointed up by rising replacement-part sales.

The same picture applies to most home appliances.

The experts point out, though, that these facts are by no means a guarantee of sales. A customer who has waited 3 or 4 years for a new model can just as well wait 5. —ARG

Rockwell-Standard helped make this husky hauler a marvel of maneuverability!

Powerful enough to handle huge payloads . . . yet maneuverable enough to negotiate the narrow tunnels and close quarters of rugged underground mining operations!

This is the unique combination of qualities required in heavy-duty mine hauling equipment – qualities which the KW-Dart Truck Company *has built* into its new diesel shuttle truck illustrated above.

To help meet these exacting needs, the manufacturer called on Rockwell-Standard—*specialist in planetary-drive axles.* By modifying a pair of its standard steering planetary axles, Rockwell-Standard provided the answer . . . a powerful high-torque driving assembly with four-wheel steering that permits the truck to "crab" and maneuver in and out of tight places.

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Timken-Detroit Steering Planetary Axle

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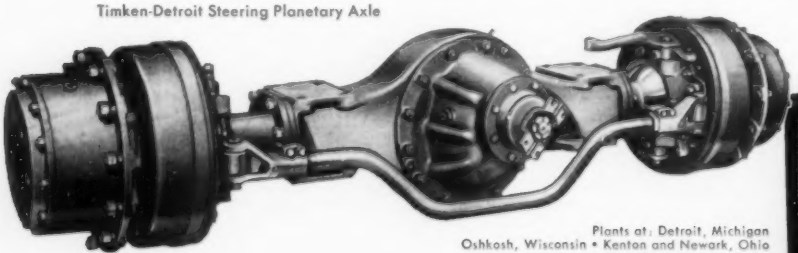

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DEVELOPMENTS TO WATCH...

More Budget Squeezing is being Mapped Out . . .

by the Pentagon. Next year's budget is being whipped into shape now, and the military brass are faced with the problem of how to hold the line of expenditures at a time when costs are climbing.

It has brought on one of the sharpest appraisals of weaponry since the end of the Korean War. Congress voted $40.8-billion for the Dept. of Defense this year. Both the Treasury Dept. and the Bureau of Budget are pressuring the Pentagon to hold to this level, even squeeze it down closer to the original $39.8-billion budget submitted to Congress last January. To do so will take penny-pinching, mean throttling back on some of the big missile programs. Even so, 1960's budget may climb another $1-billion.

Here is What to Expect in the Year Ahead . . .

Manpower. Cuts will be made to trim the total active military forces to around 2.5-million by next July. It will mean close to an 80,000-man reduction. This seems relatively sure in spite of Congressional opposition. In fact, Congress voted money to add some 55,000 additional personnel to the Armed Forces.

IRBM. A selection will be made shortly between the Air Force's Douglas Thor and the Army's Chrysler Jupiter Intermediate Range Missiles. Both are in production now, but it costs at least $100-million a month to do so. Tentative plans call for the Air Force to operate three Jupiter squadrons and seven Thor units.

Air Defense Missiles. Both the Army's Western Electric-Douglas Nike Hercules and the Air Force's Boeing-Westinghouse Bomarc, with ranges between 100 and 200 miles, will be kept in production. But, the output will be much lower than what each service would like.

B-52 Heavy Bombers. Air Force wants an additional wing of these bombers over the 12 wings already scheduled. But, odds are against an okay for the measure. Another 39 of the bombers have been ordered from Boeing to keep production going into 1961. This will round out the 12-wing force. Chances are some better for the Air Force to get more of the big jet tanker Boeing KC-135 planes.

Troop-Carrier Aircraft. Congress voted an additional $136.1-million for airlift planes. This is short of what the Army wants. But, the outlook is slim even to spend the extra money Congress voted.

Polaris-Armed Submarines. Nine of these submarines have been okayed with a good supply of missiles. Navy will push the program with full Congressional backing, but the Pentagon wants to slap a check rein on the project. For one thing, it wants to see the missile-sub combination work before more money is pumped into the program.

Atomic-Powered Aircraft Carriers. One is building and Navy asked for $35-million to start another carrier, but Congress turned thumbs down on the project. To many top military strategists claim the aircraft carrier is on its way out.

Aid to Small Business . . .

has Congressional support, as it proved this year.

It made the Small Business Administration a permanent agency. It gave the SBA an additional $120-million for its loan program. It raised to $350,000 the maximum individual loan permitted.

And it gave SBA a brand new kitty of $35-million to be passed out in grants—via the States—for any kind of research or advisory program that's considered an aid to small business.

Technical research can qualify for a grant under the program, but SBA officials guess privately that the first projects to be approved will be those proposed by business colleges and universities in the general field of management aids to small business.

The specifications for a grant are these: only one project can be approved in any one state in any one year; maximum grant is $40,000 per project. The SBA can back almost any proposal that it chooses.

The law says it can make grants for study, research, and counselling concerning the managing, financing and operation of small business enterprises, and the development or distribution of technical and statistical information that would support small business.

The $35-million fund is one that Congress has votel for several years to Federal Reserve banks to lend help to small business, but which was never utilized. As Congress was going home to election, it slipped through a bit of legislation transferring the money to SBA.

World-wide ...

DEVELOPMENTS TO WATCH...

Pressureless sintering process . . .

. . . that can produce high-density powdered metal parts is claimed by researchers at Britain's Atomic Weapons Research Establishment.

Working with loose beryllium powders, they report producing a wide range of shapes, "including hollows made on a graphite core," with densities of 95 to 98%. Even sharp corners can be reproduced, they report. Shapes can be used direct, or machined, extruded, or rolled to sheet; and parts can be welded.

Describing the sintering method at the Geneva Conference on Atomic Energy, they said powder of critical particle-size distribution (minus 200 mesh—about 35 microns) is sintered at 2200 F for 6 hr in a graphite mold heated by induction in vacuum. The molds are filled simply by feeding the powder to a bulk density of 45 to 50%; and a modified vacuum casting furnace is used.

Control of sintered dimensions appears reasonably good, and it is subject to improvement. Right now, a tolerance of about plus or minus $\frac{1}{8}$ in. can be held on a 4-in. cube or right cylinder. The AWRA researchers do admit, though, that "even under the best conditions, the new process could not be expected to compete with the high degree of dimension control obtained by conventional consolidation techniques."

The Soviets are talking big numbers again . . .

. . . but their claims may be worth study.

Like US scientists, Soviet technologists are investigating the effects of ultrahigh pressures on materials, and they've created, by percussion means, pressures as great as 5 million atmospheres. At these pressures, many of the phenomena associated with ultralow temperatures (*PE—Sept 8, p 10*) have been observed. Water crystallizes in new forms and insulators become highly efficient electrical conductors.

In the atomic field, too, the Russians are up in the high numbers; this time with a 50-Bev particle accelerator—five times as large as their previous record-breaker will have a 22,000-ton electromagnet, fed by a 100-megawatt source.

(Note: For a full-scale report on Soviet products and projects, see PE's July 14 issue.)

An automatic channel-switcher . . .

. . . that "translates" audio and visual TV signals from one frequency to another without demodulation has been developed for the British Broadcasting Corp. Its purpose: to provide supplementary coverage in areas where reception is unsatisfactory.

The unit is basically a low-power transmitter, simplified by eliminating demodulation elements, and miniaturized with transistors. It does, however, have a dual frequency-changing system, designed to provide protection against in-band feedback and to improve rejection of spurious signals. One frequency changer brings the signals down to 34.65 and 38.15 mcs; the other produces output signals in the desired channel.

First installation is at Folkestone, but BBC plans to install several others in its VHF system.

Filter elements at ⅓ the cost . . .

. . . of those previously used have been developed by Measurements, Ltd, Lancashire, Eng. These are plastic filters that replace nickel and monel in water meters, and give better service. It was difficult, the company says, to perforate the metal sheets in the desired hole sizes; and mesh did not prove entirely satisfactory as a filter. Furthermore, the metal corroded in some waters.

The company is now standardizing on the new design for all of its meters, makes several types.

Plastic filter designed for water meters is cheaper, better than metal. Impact polystyrene is the filter material.

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What's happening in SCIENCE

Assisted solutions

An unusual solvent effect that might open the door to new electrochemical techniques was highlighted by two NYU chemists at the ACS meeting last week.

It has recently been discovered, they noted, that certain alkali metals display a limited solubility in polyethers —derivatives of ethylene glycol, for instance. The resulting solutions are electrically conductive; and the solubility is highly selective.

As one example, potassium will dissolve in the dimethyl ether of polyethlene glycol; sodium will not. But . . . When an alloy of sodium and potassium is exposed to the ether, the resulting solution is found to contain both metals. The soluble metal seems to help its companion get in the swim.

Theoretical explanations are still being developed; but this alloy-assistance effect might prove useful even before it is completely understood.

Measuring temperature in the millions

Creating the multimillion degree temperatures that are required for thermonuclear reactions is tough enough. But how do you measure these H-bomb temperatures?

Surprisingly, it turns out to be rather a simple problem, in some cases at least. The British have found it possible to take advantage of an old and respected principle—the Doppler effect (*PE—Nov* 18, '57, *p* 15—to solve this problem-of-the-future.

As they point out, atomic nuclei in the hot gases in which fusion is expected to take place are moving at high speed, and that speed is a function of temperature. They are also continually picking up and spewing forth electrons. As they do, they emit visible light. The frequency of this light, like the pitch of a train whistle, depends on the speed of the source and its position relative to the measuring device. By measuring the shift in the light spectrum, then, a direct estimate of temperature can be obtained.

Gravity-control theories can pay off

If you have an idea on how to control gravity or screen it off, get ready to enter the Gravity Research Foundation's annual essay contest. It offers awards ranging from $100 to $1000 for "the best 1500-word essays on the possibilities of discovering: (a) some partial insulator, reflector or absorber of gravity; (b) some alloy or other substance, the atoms of which can be agitated or rearranged by gravity to throw off heat; or (c) some other reasonable method of harnessing, controlling, or neutralizing gravity."

The deadline for next year's competition is still six months away; but it's not too soon to start thinking. A booklet containing previous award-winners is available from GRF, New Boston, N. H. For more information see *PE—Dec.* 30, '57, *p* 12.

briefs . . .

Dislocations in metals are being studied at Oak Ridge National Laboratory with the aid of neutron irradiation techniques. Measurements of Young's modulus and of internal friction (both extremely sensitive to dislocation in the crystal lattice) have been made on copper single crystals, and other data expected to help control brittle fracture and creep.

Noble gases can act as catalysts, promoting reactions in other gases, even though they do not react themselves, Vanderbilt U researchers report. Using X-radiation to produce polybutadiene and acetylene compounds, they found that addition of argon to the reacting gas increased the polymerization rate by a factor of 30; krypton increased it by 60; and xenon stepped it up by a factor of 150.

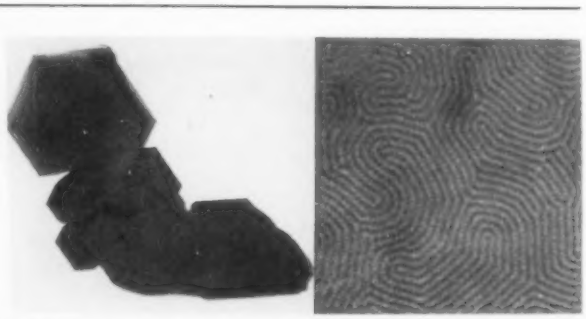
Hypsometers are the latest aid to high-altitude weather studies, and put another old principle to work. As explained by General Instrument Corp the hypsometer measures altitude by the boiling of a liquid and the temperature change of the evolved gases. It consists of a tiny "vacuum bottle" with a thermistor in its neck. Inside the flask is carbon disulfide which boils at very low temperatures and pressures. As the weather ballon rises, the liquid boils and the temperature of the evolved gas drops. Comparison of its temperature with the outside air indicates both atmospheric pressure and altitude. —ARG

Looking directly into magnetism

Transparent ferrites are the latest addition to the roster of compounds that can help extend our knowledge of magnetism and magnetic domains.

Like yttrium garnets (*PE—Jan.* 27, *p* 14), the new ferrites make it possible to view patterns of magnetization directly (see photo) instead of merely inferring them from the configuration of iron powder particles or special coatings sprayed on a magnet's surface.

Yttrium garnets, however, are "soft" materials that cannot be permanently magnetized. The new materials, synthesized by DuPont's Pigments Research Laboratory, are "hard" magnetic compounds that take permanent magnetization.



New ferromagnetic crystals are transparent, can be permanently magnetized, display magnetic domain patterns, like those at right when viewed in polarized light. Crystals here are barium compounds, but DuPont has also produced transparent strontium ferrites.

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Series 600 Caster with V-grooved wheel eliminates ten handling operations in production assembly of refrigerator and freezer doors.

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Your nearby Faultless Industrial Distributor maintains a substantial inventory of Faultless Casters for immediate delivery. He and one of the strategically located Faultless Sales Engineers are available to work with you on every handling problem in your plant. Both are listed in the phone book Yellow Pages, under "Casters," beneath the Faultless heading.

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Better strip from metal powders

A six-year research program is about to pay off, says E. W. Bliss Co, in commercial production of high-quality metal strip by a new process. It's said to produce stronger metal with lower oxygen content, and do it at savings of about 80%. First commercial application is expected to be in copper; but the technique can also be applied to other metals—aluminum, for instance.

In contrast to standard methods, the new process starts with metal powder, rather than a cast slab or ingot. The powder is compacted and sintered, then can be rolled while still hot from the sintering operation.

According to Bliss, copper strip produced this way averages about 10% higher in tensile strength for comparable elongation than electrolytic strip, and oxygen content is less than half as much in some cases.

Chemetals Corp, New York City, holds the patents on the process and is ready to license its use. Bliss will supply the equipment.

New jobs for calcium

Calcium metal is scheduled for new attention as Beryllium Corp of America and Charles Hardy, Inc prepare to market it for product use. Beryllium Corp will produce the metal, using new techniques which, it says, make it possible to turn out rather complex extruded shapes and foils down to 0.005 in. thick, as well as rod and sheet materials. Hardy will handle national distribution.

Calcium is a reactive metal of the alkaline earth group which also includes strontium and barium. In many respects, though, it resembles magnesium. It has a strong enough affinity for oxygen and other gases to rate consideration as a light-source for high-intensity photoflash bulbs and as a "getter" in electron tubes. Its chemical reactivity suggests possible use as a neutralizer for crankcase lubricants. (A slug of calcium about 1 by 1¼ in. might be attached to the crankcase to neutralize crankcase acids and extend life of both the lubricant and the engine.)

Calcium melts at 1560 F and boils at 2600 F. It can be cold-worked to a tensile strength close to 17,000 psi (annealed strength is about 7,000 psi.) Electrical resistivity and thermal conductivity are roughly comparable to those of magnesium, and calcium is a little lighter in weight.

Base price of calcium metal in 99.9% purity, in small lots, is $4.55/lb. Simple extruded shapes can be supplied for about $10/lb, though close-tolerance sheet is considerably more expensive ($18 to $24). However, it's expected these prices can be brought down as production increases.

briefs . . .

New resin finishes will be dolling up the Big Three's 1959 cars with longer lasting gloss. GM is switching to new acrylic coatings (*PE*—Sept. 15, p 00) while Chrysler is betting on epoxy and alkyd types.

At Chrysler, the claim is "up to twice the durability and fade resistance" of previous coatings, and ability to take "as long as two years in average service before anything more than a wash is required."

The Chrysler primer and top coats are both new. Primers are epoxy-based; while top-coat enamels are alkyds, but have coconut oil in place of soya or linseed compounds, and two to three times as much melamine as in earlier formulations.

Polypropylene plastic "in market development quantities" will soon be available from a new source: Enjay Co (Standard Oil of NJ. subsidiary). Already marketed in this country by two companies (see below and *PE*—Aug. 11, p 12) the plastic is to be produced and sold under a dual arrangement: Enjay will be primary producer and market the plastic through its own sales organization, but will also supply Spencer Chemical with the material for resale. (For a full-scale report on this new plastic and two others, see coming Sept. 29 issue.)

Substantial price reductions are posted by several plastic and resin producers in a frank effort to spur development of new uses. Among recent cuts:

Polypropylene, reduced 9¢ a lb by Hercules, to a base price of 49¢.

Epoxy resins, dropped 5 to 6¢ a lb to the range of 53½¢ for solid resins, 62¢ for liquid, by Shell Chemical Corp.

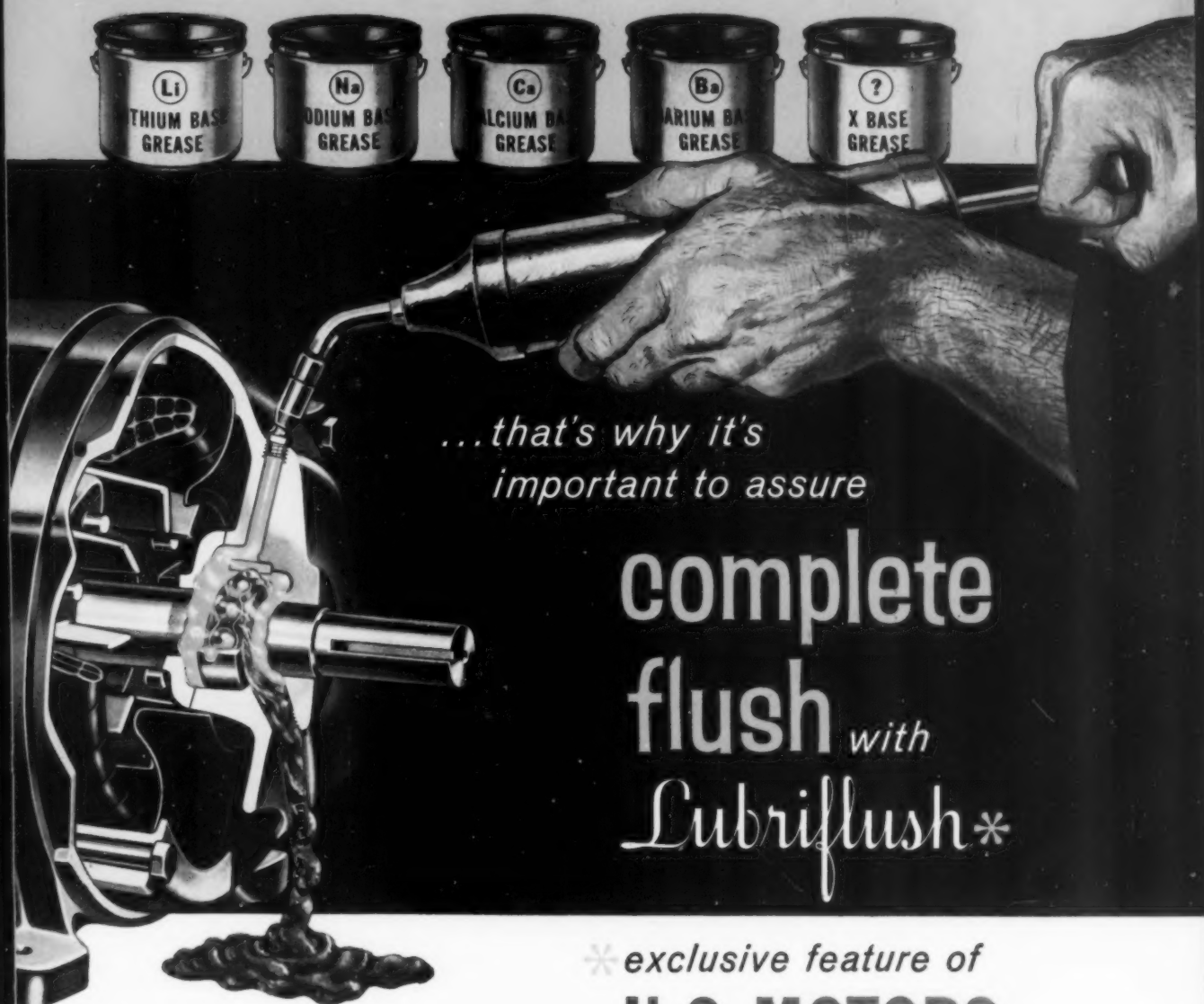
Silicone rubber, solvent-resistant type, down $2 to $3 a lb to $22 in 1000-lb lots for Dow Corning's Silastic LS-53. —ARG

Ti and Zr at half the cost

Cast titanium and zirconium valve parts, and complex impellers like the one pictured here can be produced at considerably lower cost than has previously been possible, says Oregon Metallurgical Corp, Albany, Ore. Recent improvements in casting techniques permit substantial cost reductions —50% or more in the larger sizes —in such items as diaphragm, pattern Y, and glove valves. Oremet is ready to produce them commercially; is also working on other techniques for fabricating these metals.

New casting techniques permit substantial reductions in cost of titanium and zirconium parts like this 5-in. centrifugal-pump impeller. Oregon Metallurgical is making them.

modern greases are not always compatible...



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Today's greases have different chemical bases—lithium, sodium, calcium, barium, and other bases which your people can't be expected to keep track of. Some of these greases will not mix safely with others. Because certain chemical bases may react with each other, mixed grease may change its characteristics and become unsuitable for bearing lubrication. That is why U.S. LUBRIFLUSH—an exclusive feature of U.S. Motors—is so important. With this transverse lubrication system, old grease is *completely* flushed out as new grease is forced in. There's no mixing. New grease can be put in without bothering to determine whether it's basically compatible with the old. LUBRIFLUSH, moreover, assures proper lubrication for longest bearing life. Another good reason to specify: "U.S. ELECTRICAL MOTORS."

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when strip-outs cause re-do's!

"Take any operation where assemblers must match-up tapped holes, avoid cross-threading, and drive machine screws into place—and you could be sitting on dynamite.

"When strip-outs occur (and they will), work stops or the piece must be removed from the line. The hole must be enlarged, re-tapped, a larger screw used, and you know what this means to employees working under a bonus plan.

"Or take the case of our *Portagraph* units," says MR. E. G. LAYER, ENGINEERING SUPERVISOR AT REMINGTON RAND SYSTEMS DIVISION IN TONAWANDA, N. Y. "Here, where plastic sockets are mounted, assemblers had to hold nuts in place under a steel sheet while screws were driven down from above. Get on the receiving end of bitter complaints about cut and bruised fingers, and you start looking for a better solution in a hurry."

The solution to both problems was simple. When Remington Rand switched to PARKER-KALON SELF-TAPPING SCREWS, these labor grievances quickly disappeared. If you'd like advice on proper types of fasteners for your product, a Parker-Kalon Field Engineer will be glad to be of assistance.

For light and heavy gage metals, ferrous and non-ferrous castings, bronze and brass forgings, structural steels, resin impregnated plywoods, woods, asbestos compositions, and plastics of all kinds, specify . . .

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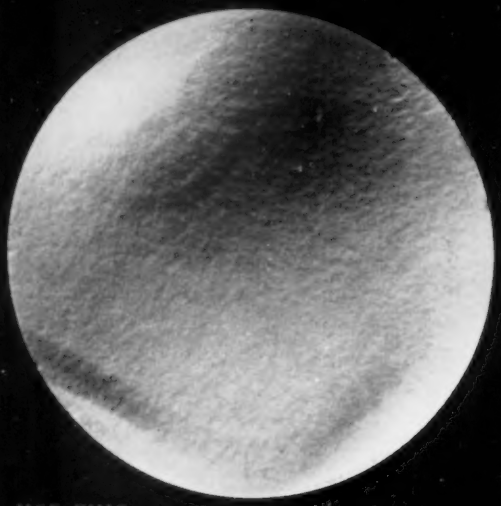

USE THIS

This is an unretouched photo of a broken 3" thick section of Coors high alumina ceramic, formed by the *Isostatic Process*. It fractured smoothly and shows a completely homogeneous structure. There are obviously no voids or hidden stresses to cause failure.

NOT THIS

This is an unretouched photo of a broken 3" thick section of high alumina ceramic, formed by the conventional wet process. It clearly shows typical voids and hidden stress patterns inherent in all conventionally made, wet process ceramic parts.

COORS TECHNIQUE PRODUCES UNIFORM PARTS WITH NO HIDDEN VOIDS OR INTERNAL STRESSES

Design uncertainties of ceramic strength and unformity are completely eliminated by the use of Coors Alumina Ceramics formed by the *Isostatic Process**. There are no variations in properties between one ceramic part and another. This is the only ceramic forming technique that can guarantee uniformity between ceramic parts.

Outside of the spark plug field, Coors has pioneered in isostatically forming high alumina ceramics. In this forming technique, blanks are initially produced by pressing dry, unfired powder in a rubber mold under high hydraulic pressure. An accurate inside contour can be formed by pressing the powder around a metal arbor. The uniform pressure from all directions provides uniform compactness and complete homogeneity. The final outside shape is formed by machining the blanks.

In a wet process, the ceramic parts, once formed, must be dried. This drying action causes hidden stresses to develop. And finally, the volume occupied by the water is replaced by air, forming hidden voids and weak spots.

Since the powdered ceramic material used in the *Isostatic Process* is dry before it is formed, the machined blanks go directly into the high temperature kilns. Unpredictable drying necessary in wet processes is thus eliminated.

With Coors Alumina Ceramic parts made by the *Isostatic Process*, the engineer can accurately design for mechanical and electrical properties—an impossibility with any ordinary methods of forming ceramic. For complete mechanical and electrical properties, send the coupon below. Parts to test your design will be furnished at nominal cost.

**Coors Porcelain Company operates under license for this patented process from Champion Spark Plug Company, Toledo, Ohio.*

COORS PORCELAIN COMPANY

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Please send me detailed Bulletin 1055-A on Coors High Strength Alumina Ceramics and Coors manufacturing facilities.

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Please refer to our 12-page catalog in Sweet's Product Design File

New program timer features complete adjustability

In many applications, a timer has a "standard" job to do throughout its expected life, never requiring a change of timing sequence. But in many others, it's desirable to be able to change the timing sequence and the intervals making up the sequence in a complete cycle.

The new Cramer Type 511 and Type 521 Cycling Timers fill the bill for a unit combining high accuracy with complete field adjustability of as many as eight individual timed intervals. Although these timers can be supplied with preset cams to fit the needs of a present application, the added feature of adjustability makes them the ideal choice where the timing sequence may later be changed.

Operation

Applying power through an external sustained contact starts the timer, which continues to cycle until the control contact is broken. Full cycle time is the total time range of the timer specified, and may be selected from a large number of available ranges. If desired, the timer can be wired to perform one cycle and stop.

At the start of each cycle, the snap-acting SPDT load switches are in the initial positions specified (or established through adjustment) by the user. As the cycle progresses, each load switch is transferred by its operating cam to open or close its connected circuit at the required time and for the required duration.

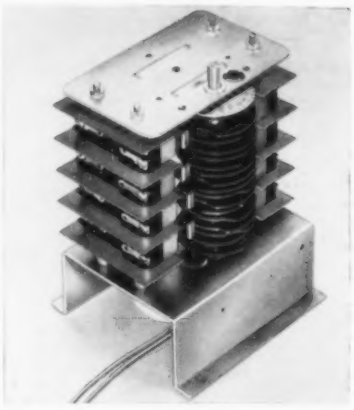
Timing Cam Adjustment

Each SPDT switch is operated by a double cam, one section to close the switch to one contact, the other to close it to the opposite contact. Depending on circuit wiring, either of these actions can "make" or "break" the load circuit. Each section of each cam is independently adjustable through a full 180°, without disturbing any other cam setting, by means of a small spanner wrench furnished with the unit. Adjustment is indicated on a dial which is marked in percent of total cycle time, permitting accurate selection of the desired "make" and "break" points for each load switch.

Features

TIME RANGES — From 1 cycle in 6 seconds to 1 cycle in 48 hours.

LOAD CIRCUITS — From 1 to 3 (Type 511) or from 4 to 8 (Type 521), each controlled by a totally-enclosed quick-make quick-break SPDT switch rated for 20 amperes at 125 or 250 volts AC (non-inductive).



Field-Adjustable Program Timer Type 521

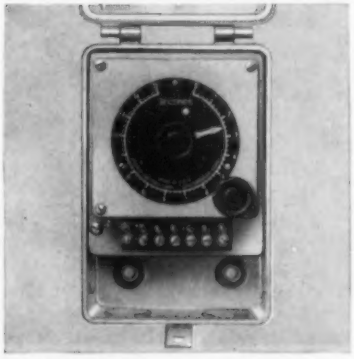
OPERATING TIME — Minimum operating time for each circuit is approximately 1/30 of total cycle time.

ACCURACY — At operating point of any one circuit, 1½°; between any two circuits, 3°.

MOTOR — Cramer high-torque synchronous, for 115 and 230 volts, 25, 50 and 60 cycles. Motors for operation on DC or at other frequencies are available in limited time ranges.

For detailed information and complete specifications, write Cramer Controls Corporation, Box 7, Centerbrook, Conn.

THREE MORE WAYS TO SOLVE YOUR TIMING PROBLEMS

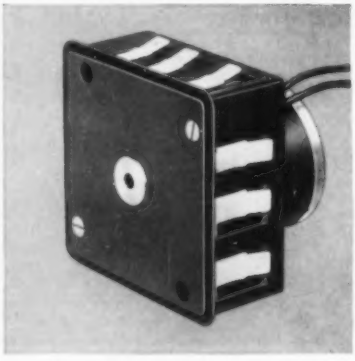


VARIABLE-CYCLE PULSE TIMER TYPE 650

Makes or breaks an electrical circuit for a fixed period or "pulse" of ½ second to 12½ hours, at continuously repeated intervals that are adjustable from ¾ second to 24 hours. By choice of load connection, control can be based either on the fixed pulse time or on the adjustable interval between pulses. Cycling period can easily be changed during operation.

ADJUSTABLE PERCENTAGE TIMER TYPE 610

Makes or breaks an electrical circuit for a variable percentage of a basic fixed cycle time. Desired percentage of total cycle time, for ON or OFF control of the timed device, is adjustable from 4% to 96% in steps of 1%. Total cycle-time ranges from 15 seconds to 24 hours. Internal connections can easily be arranged so that the load circuit is either closed or open for the indicated percentage of the full cycle.



CYCLING TIMER TYPE 571

Provides reliable and inexpensive control of repetitive switching for built-in applications. One through four poles, SPST or SPDT open-blade switches with contacts rated at 30 amperes, each controlled by a timing cam specially cut to user's requirements. 18 standard speeds from 1 rpm to ⅛ rpd, plus many special time ranges.

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When you need steel fasteners that look their very best, order Bethlehem electroplated fasteners.

Bethlehem bright-zinc-plated fasteners enhance the appearance of bolting applications because they have a smooth finish that is shiny and rich-looking. They meet ASTM Specifications A-164-55 RS, LS, and GS, and can be produced with definite classes of thread fit in all sizes up to a length of about 30 in.

Bethlehem cadmium-plated fasteners are also available, made to ASTM Specifications A 165-TS, OS, and NS. Type TS is the most popular thickness.

Where conditions call for increased resistance to certain types of corrosion, we have the facilities to passivate electroplated fasteners by means of a dichromate dip, or by using surface conversion coatings, such as iridite and cronak.

Regardless of the styles or quantities you need, just say the word, and we'll have a representative call to tell you more about electroplated fasteners.

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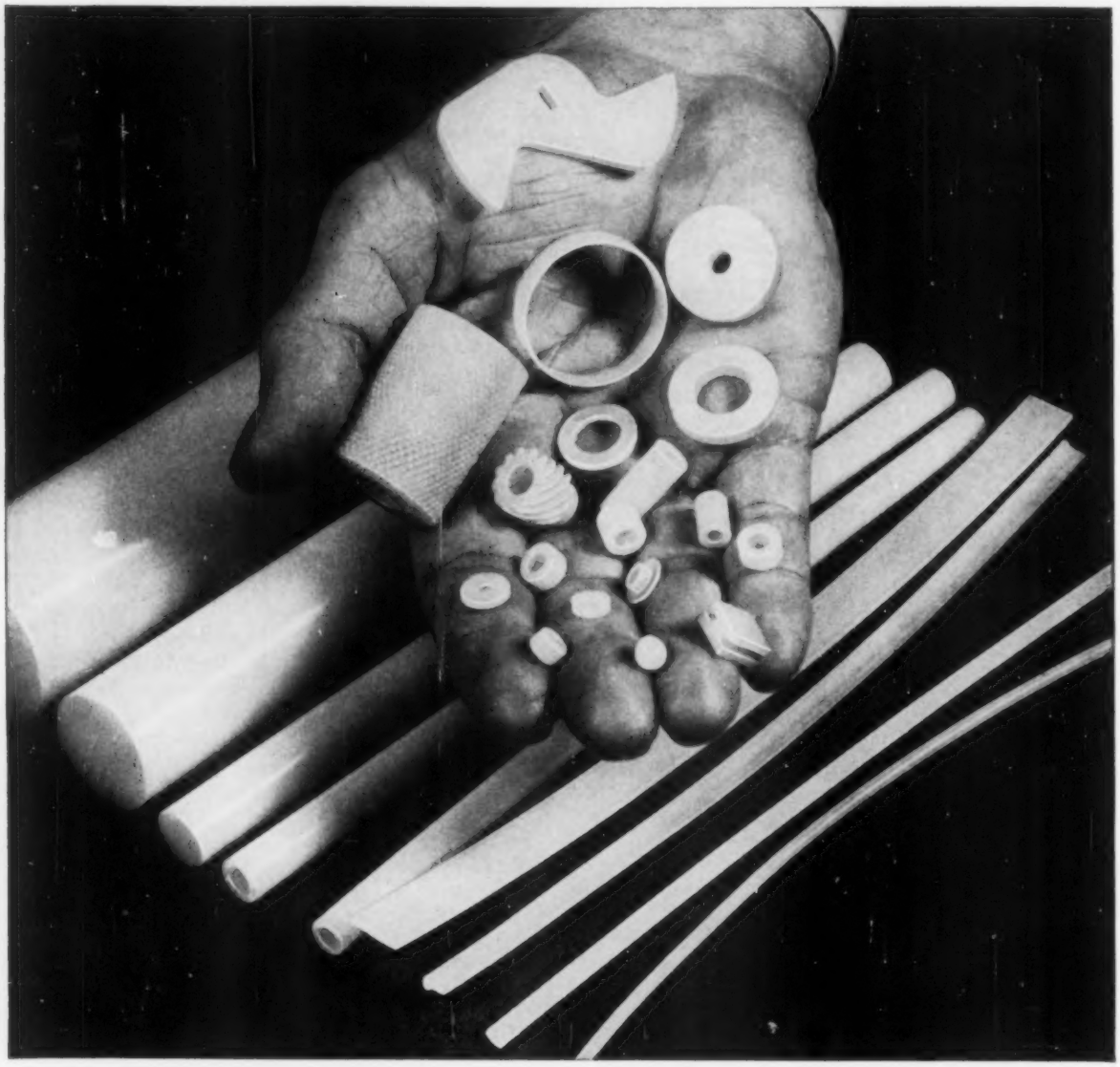

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For fabricated parts—or for extruded strip, rod, tubing or special shapes—you'll find National a dependable primary source of Nylon. Costly molds and time delays may favor the delivery of 100% usable parts fabricated from National Nylon and timed to your production needs.

In many cases, fabricated parts from standard or special extruded shapes give you more design freedom at no greater unit cost. Buying from the source makes this possible. Before you "freeze" a molded design, talk with your National Sales Representative.

Check him, also, for your other basic materials needs—PHENOLITE® Laminated Plastic, Vulcanized Fibre, PHENOLITE Copper-clad. Many grades from the more than 100 available—including Nylon rod—are "in stock" for immediate shipment. For Nylon sizes, grades and properties, write Dept. H-9 for our Technical Data Folder.

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Product Engineering HORIZONS

September 22, 1958

east is east

I flew into Moscow in a TU-104, at 500 to 600 mph and 30,000 to 35,000 ft altitude. This is the fastest, most uptodate passenger transport in regular service, and the Russians are reportedly planning to sell it.

Seats are commodious and comfortable (2 on left, 3 on right), there are Persian rugs in the aisle, the interior is clean and open. The reading light is built into the seat ahead and looks like an automobile ash receiver inverted. Walls are trimmed with occasional pillars with bronze caps and there are plated-tubing parcel carriers above.

But the quiver you feel when a DC-7 hits a cloud becomes a solid slam in a TU-104, as if you had walked into a barn door in the dark. It's noisy; there are no air vents, no stewardess-summoning buttons. The reading light is neither directable nor efficient. Each seat has an oxygen mask built into the lower back; I wish I'd used mine because the cold I picked up before I started was driven into my ears so I could scarcely hear for days—the cabin was underpressured.

I'm reminded of these things by an article in "The Aeroplane" (London) for May 20, that discusses the barriers to effective East-West trade in capital goods. The author points out the immense difficulties in distance, in language, in writing, in methods of doing business, and in ideology if we raise the business curtain. It's one thing to trade foodstuffs and timber—they're relatively simple. But highly technical goods —like airplanes, machine tools, instruments—are something else again, particularly when you consider that the USSR and the West have been living separate lives for 40 years.

There's the problem of conveying information—not just an instruction manual, but the details an engineer wants to know. There'd have to be factory visits, test data and design data available, proof that the object met all safety and performance requirements in the country to which it would go. Yet, between Russian and non-Russian, even ordinary conversation is difficult, technical conversation almost impossible. Even the most competent interpreters fall down in this area. Two interpreters, one a resident specialist at the plant, accompanied me on my visits, and both were frequently at a loss for words in a general technical discussion.

In way of life and way of thinking we have no common ground, so there are endless chances for trouble there too. Can you imagine a Western purchaser having the run of a Russian plant, or being able to explain why we want certain electrical arrangements, less noise, predictable life between overhauls, prompt and easy maintenance, ready availability of spares, factory service, certain finishes and controls? There are opportunities for endless misunderstandings and consequent trouble.

A really important problem is that of making engineers in the buying country believe the product is good. We'd have no trouble selling the USSR cars, buses, locomotives, household appliances, washing machines and office machines—theirs are carbon copies of our anyway. For the same reason, they'd be able to sell us, or compete against us in world markets. But go into the area in which the USSR has followed an original path of development—jet aircraft, rockets, electronic equipment, automatic machine tools—and all the problems are there.

Kipling wasn't perpetually right when he wrote, "East is East, and West is West, and never the twain shall meet." But he is right at the moment.

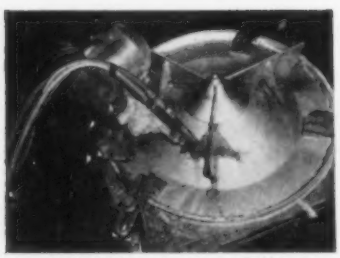
Take a new look at

TITANIUM

Tough to fabricate? Not today. With Mallory-Sharon's strict quality control and continuous research, titanium becomes a metal of uniform quality and predictable characteristics. It's being successfully machined, welded, formed to exacting specifications . . . in both aircraft and commercial applications.

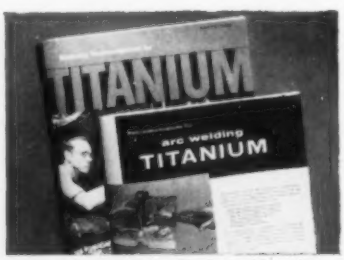
Check the examples shown here... then contact us for technical data or assistance on your specific application.

For Machinability—*Improvements in the chemistry of titanium now permit it to be machined as readily as stainless steel. Mallory-Sharon guarantees a maximum of 0.1% carbon—an element that causes machining difficulties if present in higher proportions.*



For Weldability—*Commercially pure titanium and some titanium alloys can be arc welded with good results, provided weld area is protected from contamination by the surrounding atmosphere. Other satisfactory methods include spot, seam and flash welding.*

For Formability—*Titanium sheet as stretch-formed for jet engine pod. Since Mallory-Sharon titanium is certified in a definite strength range, spring-back is predictable and allowed for in dies. Fabricators report very low scrap loss with uniform strength material.*



For Technical Data—*Technical brochures are available through Mallory-Sharon on machining, welding and forming of titanium. Write us for literature on the process in which you are interested. Our strong Service Engineering group is available to assist you on specific applications.*

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Integrated producer of Titanium • Zirconium • Special Metals

British Slash Weight, Size of Aviation Equipment

FARNBOROUGH, ENG.—Reductions in size and weight of airborne electronic equipment—resulting from the trend to transistors—highlighted the annual aircraft and equipment display here. However, use of transistors in product design is still behind US because availability of transistors doesn't match the demand.

• Electronic amplifier from Standard Telephones and Cables Ltd is less than ¼ the weight of its tube counterpart and consumes 1/20 the power. Airborne teleprinter equipment which receives and prints continuous weather reports at 100 words a minute weighs 45 lb and consumes 1.5 watts. It is currently in experimental use by BOAC. The same company emphasized the importance of transistors in an extremely accurate radio altimeter for the blind landing systems now under development in Britain. The instrument reads height to within 12 in.

• An overspeed and engine-rotation indicator, claimed to be the first item of airborne control equipment to be fully transistorized, was introduced by Pye Ltd. The unit, which uses potted components and printed circuits, was developed for the Rolls Royce Conway bypass engine. It gives a flashing-light indication; only moving part is a small, engine-mounted tacho-generator.

• Electrical highlights at the show included a brushless altenator that has silicon rectifiers rotating with the shaft. Rectifiers feed d-c excitation current to the main alternating field from a built-in exciter. The oil-cooled alternator is continuously rated at 40 kva for power factors between 0.75 and 1 and weighs only 87 lb. The unit has 3-phase star connections per 208/120 volts, 400 cps.

ADVANCE IN LIQUID COOLING

New liquid cooling techniques for airborne electronic equipment, featured by the Royal Radar Establishment, were claimed to be superior to other cooling systems on a weight and pump-load basis. This advance was required for the British supersonic airliner project. In such aircraft, adiabatic compression of air gives ambient temperatures around 300F, making it impractical to use air as a heat transporter or low temperature heat sink. But the liquid-cooled system is said to have important advantages even with subsonic aircraft.

Components are closely mounted either side of a ducted aluminum sheet that forms part of the closed liquid-coolant circuit. This sheet is rigid enough to act as a chassis and can easily be bent into U- or S-shape for containment purposes. In supersonic installations a sealed cylindrical container is mounted in a Dewar-type flask. Coolant is passed through a heat exchanger to slightly preheat the fuel.

High heat-transfer characteristics stem from ability to tailor the cooling-duct matrix to suit areas of different heat loading in the chassis. The need to obtain thermal segregation of "hot" components by space separation is largely removed; resulting proximity of coolant to heat sources leads to compactness and flexibility of the circuit layout. Higher thermal loadings can be tolerated, and transistorized equipment can operate within narrower temperature limits.

Weight advantages of the system, when compared with air cooling, result from the thin, small-dia piping and lighter circulating hardware. Pumping losses are also lower—only "a few per cent" of the circuit power loading.

OTHER SHOWPIECES

• Pneumatic slideways, and special floating recirculating ball nuts and lead screws using preloaded balls were featured in a 3-dimensional, tape-controlled inspection machine shown by Royal Radar Establishment. Measuring-head stylus of the machine is controlled to follow nominal shape of the component. Form or positional error causes movement of the stylus, which is recorded. A perfect component produces no stylus movement: recording is a straight-line.

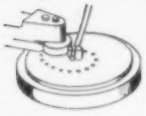
• New auxiliaries included a lightweight air-operated hoist for turbine-powered helicopters. It has a capacity of 440 lb for a weight of only 24 lb. Unit has a vane-type motor supplied at 40 psi from the aircraft turbine. Maximum throughout is 0.066 lb. second. Directional lift valve is electrically operated.

• New cast light alloy of interest

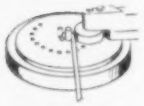
Turbo tugboat for airliners . . .
Powered by a 240-bhp gas turbine engine, this 5-ton vehicle can be coupled to the landing gear of a big jet airliner (here the Boeing 707 jet Stratoliner) while friction rollers at rear of the tug rotate the aircraft's wheels, using the plane's weight for traction. Only 49 in. high, the tug easily drives beneath wings of modern aircraft. "Turbo-tug," developed by Napcoo Industries Inc, Minneapolis, also contains a second Boeing gas turbine, rated at 210 air hp, which has a single-stage centrifugal compressor to supply air for starting jet engines.

HOW TO BEND
BARS and TUBING

HOW TO BEND . . .
OFF CENTER EYES



1. Insert bar stock between Locking Pin and Radius Pin of desired size.

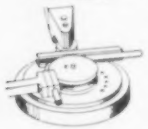


2. Set Forming Roller against material and advance Operating Arm.

3. Complete operation with one steady movement.

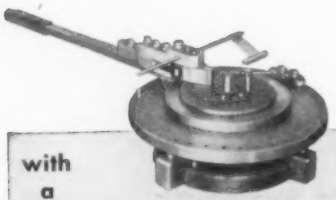
HOW TO BEND . . .
TUBING

1. Clamp tube. Insert Follow Block between material and Forming Roller.



2. Advance Operating Arm until it strikes Angle Stop.

3. Remove Follow Block, release clamp and remove tube.



with a
DI-ACRO BENDER

Complete details on forming rods and tubing with standard accessories as well as tips and technical data on angle, channel and other materials will be found in "It's Easy to Bend", a 32 page summary of Di-Acro Benders and bending. A copy is yours free of charge.

Consult the yellow pages of your phone book for the name of your nearest Di-Acro distributor or write:

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O'NEIL-IRWIN MFG. CO.
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di-acro PRECISION METALWORKING MACHINES

THE ENGINEERING WEEK

has a magnesium base alloyed with silver, rare earth metals and zirconium. The makers, J. Stone & Co, Depthford, London, have named this alloy family MSR, and claim it offers proof stresses previously available only with aluminum-base alloys. Properties require a 2-stage heat treatment. 0.1% offset yield stress is between 20,000-22,000 psi. Ultimate tensile strength is 30,000 psi with 2-4% elongation. Density is 1 oz/cu in. Creep resistance said to be good at 400F and comparable to other mag.-rare earth alloys above this temp.

• The Tyne model Shaft Turb Engine, claimed by Rolls Royce to have lowest fuel consumption of any known aircraft power plant, has high compression ratio of 13:1. For thermo dynamic reasons it most probably has high gas temperature as well, though this is not disclosed. The air-cooled blades have proved reliable in lowering metal temperatures, and a good over-all life in commercial service is predicted. The engine develops 5235 bhp, weighs 2000 lb and cruises with a fuel consumption of 0.38 lb per shp per hour. This is better than any piston-engined type and matches consumption of good diesels for a thirtieth of the weight.

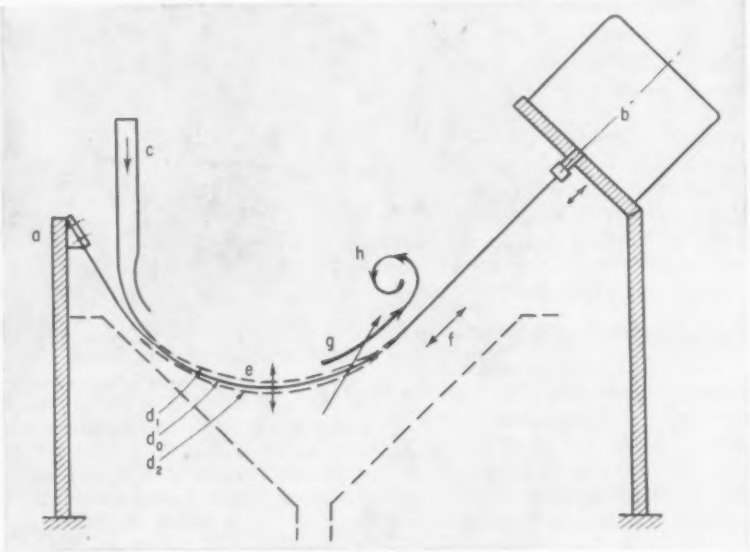
SANTA MONICA, CALIF.—Lear, Inc., manufacturer of aircraft instrumentation and flight control equipment has announced a plan to provide miniaturized automatic flight equipment for private and business plane use. He said that this will be necessary if the proposals now under consideration by the Civil Aeronautics Board are passed which would require such planes to carry equipment equivalent to that used by the commercial airliners.

Sonic Vibrating Filter Requires Less Power

BONN—Feature of a new filter for solid or viscous materials is the use of sonic power to drive the screen, with a reduction in power required. As shown in the diagram, the screen is suspended as a catenary with one edge clamped and the other edge driven by a 120-cycle electromagnetic vibrator. Drive is supported to superimpose high harmonics on the 120-cycle base.

This vibration sets up longitudinal waves at the clamped edge that gradually change to transverse waves at the bottom of the catenary to produce a strong lateral feed displacement. As liquids discharge through the mesh, solids are picked up and moved in a circular motion to form a roll that moves toward the end of the screen.

Depending on the use, up to 63 vibrating heads have been used. Also, because of the superimposed harmonic



vibrations, greater efficiency for any screen size used is claimed. The multiple head drive also permits the use of finer screens—up to 400 mesh is possible.

Built by Rhewum, Remscheid, Germany, the filters are distributed by United Specialties Co. of Illinois, 9705 Cottage Grove Ave., Chicago 28, Ill.

Iron Powder Parts Have Steel Composition

TOLEDO—An iron powder that provides 4600-steel strength levels with compositions typical of such alloys and yet is soft enough to permit briquetting at normal pressures is expected to extend the field of application of metal powder parts. Graphite additions of 1% to the powder before pressing provides 40-50,000 psi ultimate strength; 0.4 to 0.5% mixtures provide 100,000 psi; 150-180,000 psi levels are also possible—all with a single pressing and sintering and with typical powder metallurgy density levels.

Raw material is rolling mill scale, and it is the manufacturer's ability to control exactly its chemistry and characteristics that makes the new powder's higher property levels obtainable. Price is higher than for other rolling mill scale powders. Production is now under way at Republic Steel Corp., Metal Powder Div., here.

6-State Science Money Goes Mostly to R&D

WASHINGTON—In six states surveyed by the National Science Foundation, it was learned that of $69 million spent for all scientific activities during fiscal 1954, over $57 million was used for research and development.

Contained in a summary report—Scientific Activities in Six State Governments—the survey covered the states of California, Connecticut, New Mexico, New York, North Carolina and Wisconsin.

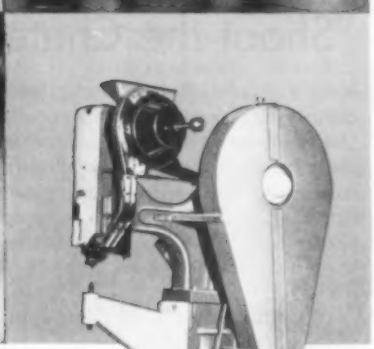
The $69 million reported as the total spent for all scientific activities represents approximately 2% of total expenditures by the states for all purposes. Some $15 million was contributed by the federal government, $48 million from the state government and more than $5 million via gifts and grants.

HERE'S HOW A MILFORD RIVETER CUTS PRODUCTION COSTS, SPEEDS ASSEMBLY AUTOMATICALLY!

The operator places the parts over the roll set plunger. A tubular rivet has dropped from the feed rails into the jaws.

As the operator trips the machine to begin the cycle, the jaws and driver automatically carry the rivet down to the work.

The rivet contacts the roll set plunger. The spring-loaded plunger recedes, guiding the rivet through the assembly where it is clinched on the underside.



The floor-mounted Riveter shown here is only one of a full line of automatic riveters by Milford. Bench or floor models . . . single or multiple spindle . . . manual or automatic operation, the Milford Riveter line is designed to solve your toughest assembly problems, can be adapted to your particular operation.

For a complete line of tubular rivets . . . for fast, trouble-free assembly . . . look to Milford!

THE MILFORD RIVET

MILFORD RIVET & MACHINE CO.

MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
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Capital Spending by Manufacturers on the Rise—Finally

WASHINGTON—As the biggest capital expansion boom in history tapered off a year ago June, businessmen began cutting their spending for new plant and equipment. The cutback produced the shortest, sharpest curtailment of capital spending since World War II and was a prime factor in the 1957-58 recession.

But Washington economists now figure that this drop in capital spending has ended—and earlier than anticipated. The outlook now is for a pickup in capital expenditures for the rest of the year, as the table at right, below, indicates.

This, at least, is the conclusion drawn from latest survey by the Commerce Department and Securities and Exchange Commission of plant and equipment plans of some 8,000 firms accounting for two-thirds of all such expenditures.

On the basis of the survey, the government forecasters figure that capital spending now would amount to $31 billion this year.

While the increases in spending plans reported during the past few months are only modest ones, the important thing to Administration economists is that it is an increase—that a turn has been made. In a similar survey taken only three months ago, businessmen reported they expected to make further slashes in the third quarter.

The upturn already appears underway in manufacturing. Manufacturers plan to pick up spending slightly—by $40 million—in the third quarter and by a more respectable $300 million in the last three months of the year. The third quarter increase is accounted for solely by non-durable goods manufacturers; hard goods producers are scheudling a further $90 million decline (on a seasonal rate). Both groups plan fourth quarter increases.

- Primary nonferrous metals anticipate a 7% drop in the third quarter and a 16% additional reduction in the fourth quarter.
- Machinery makers expect to step up their capital spending by $49 million this quarter and an additional $33 million in the fourth quarter while the auto companies also expect a slight increase.
- Airlines are planning record expenditures in the fourth quarter as they press ahead with their jet age plans.
- Iron and steel is one of the few manufacturing industries to continue shaving outlays for the rest of the year.
- Railroads report the biggest anticipated cutback of any major group this year. They expect to spend a total of $751 million this year, almost half of what they laid out in 1957, although recent passage of railroad aid legislation may give the industry a new boost.

Table of Spending

Expenditures for new plant and equipment by quarters, seasonally adjusted annual rates.

	(Billions of Dollars in 1957) July-Sept.	Oct.-Dec.
Manufacturing	16.37	15.27
Durable Goods	8.23	7.57
Non-durable Goods	8.14	7.70
Mining	1.24	1.15
Railroad	1.54	1.26
Non-rail Trans.	1.81	1.91
Public utilities	6.64	6.43
Commercial, etc. (W)	10.15	10.21
(Total)	37.75	36.23

(W) includes trade, service, finance, communication and construction.

	(Billions of Dollars in 1958) Apr.-June	July-Sept. (1)	Oct.-Dec. (1)
Manufacturing	11.53	11.57	11.86
Durable Goods	5.57	5.48	5.54
Non-durable Goods	5.96	6.09	6.32
Mining	.92	.91	.96
Railroad	.77	.67	.50
Non-rail transportation	1.40	1.37	1.55
Public utilities	5.97	6.20	6.38
Commercial, etc. (2)	9.73	9.60	9.77
(Total)	30.32	30.32	31.02

(1)—Estimates are based on anticipated expenditures reported by business in late July and August 1958.

(2)—Includes trade, service, finance, and communications.

Army QM Engineers Design "Shoot-the-Chute"

NATICK, MASS.—A fast-opening parachute equipped with two separate explosive charges which fully inflate the chute before the jumper has fallen 13 ft has been developed by Army Quartermaster Research and Engineering Center here. Minimum time for opening a conventional parachute is five sec.

When the jumper pulls the ripcord, the first charge fires the packed canopy to the full height of the suspension, or shroud lines. The second charge shoots the canopy from the pack, fully opening the chute.

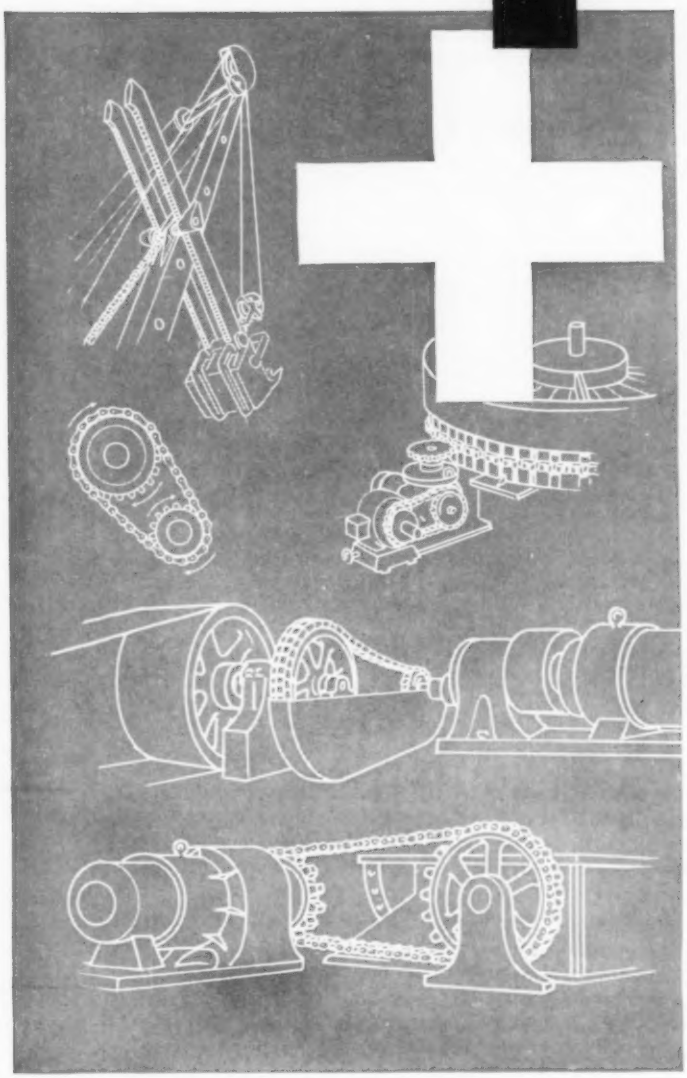
The first charge, called the projecting charge, is fired by the wearer to start the sequence of operations. When the pack has reached the full extended height of the shroud lines, the second, or deployment charge is automatically fired by an inertia actuator. The inertia actuator will fire the deployment charge only after the safety rod has been pulled out and only under a deceleration of the pack of 15 g's or more for the back-style chute, and 38 g's or more for the platform style. This takes place when the shroud lines are fully extended.

For the second, or deployment charge, 24 ejection slugs are permanently attached to the 24 shroud lines at the skirt of the canopy. These ejection slugs are shot out of the 24 ejecting barrels radially spaced around the ejector. The ejector and other parts are tied to two of the lines to prevent possible loss of these parts or injury to the jumper. A special cloth for the chute is not required.

At present, two prototype parachutes have been developed: one is mounted on a projection frame worn on the individual's back, and a later style design has the parachute mounted on the platform adjacent to the wearer with the parachute connected to the wearer's parachute harness by two long risers.

Principal reason for the development of the platform style was the desire to use a greater projection charge to increase the operational range of the parachute. The back style parachute is limited in this respect by the projection force which the human body can safely endure. Both parachutes are in engineering test stage.

to put a PLUS in your



POWER DRIVES

Plus performance, dependability, economy...these are the extras you want in your designs. But in specifying power drive equipment, how can you be sure that you're getting *plus* values?

One *sure* way is to consult your CHAIN Belt Man. Have him demonstrate the three important *plus* advantages you get with CHAIN Belt:

1. *Plus Value in Product.* Whether it's chain, sprocket, bearing, coupling, take-up, the built-in *plus* quality of CHAIN Belt products puts plus value in your equipment.
2. *Plus Value in Application Assistance.* Your CHAIN Belt Man has the know-how to help you select the right component that assures plus performance at lowest over-all cost. Because he has a complete line, he can recommend, without prejudice, the right choice for your design.
3. *Plus Value in Service.* From your CHAIN Belt Man in the field to the engineering and manufacturing departments in our plants, *plus* service is yours to command. In application, product specification assistance, deliveries that meet your schedules, CHAIN Belt has no equal.

For the story of the *plus* values in CHAIN Belt power drive equipment, turn the page.

CHAIN BELT

QUICKENS THE PACE OF PROGRESS

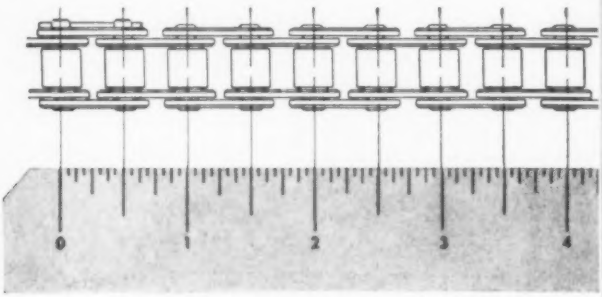
turn page

the PLUS values in...

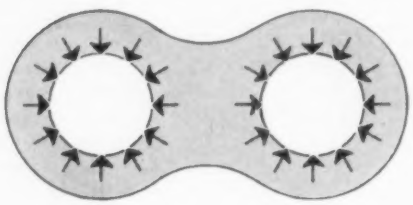
REX® ROLLER CHAIN

The quality of any roller chain can be determined by two factors... its ability to resist wear and fatigue! A chain designed and manufactured to have a longer normal wear life and greater fatigue resistance is a *plus* quality chain. CHAIN Belt's quality in design... manufacture... control... gives you this *plus* ability to resist wear and fatigue. Here are two of the many important differences that make Rex Roller Chain so superior:

IN PITCH CONTROL



In Rex Roller Chain, chain pitch is accurately controlled, not only in the pitch measurement in a chain strand *but in each link* in the strand. This means that every part of the chain carries its full share of the working load. There are no pitch variations to cause uneven loading with resulting early failures of chain parts.



IN LINK PLATES

An important function of the link plates is to maintain the pitch of the chain. To do this, link plate holes must be accurately located in relation to each other and also parallel. To control the drive fits of pins and bushings, plate holes must be accurate in size throughout the thickness of the link. Hole finishes must be smooth and uniform.

You get these features in Rex Roller Chains through a special manufacturing technique of guided piercing of link plate holes... a technique that assures the exact type of link plate hole required, and puts the *plus* wear life and fatigue resistance into these top-quality chains.

For the complete story of the plus values in Rex Roller Chains, send for your copy of Bulletin No. 5725.

CHAIN BELT

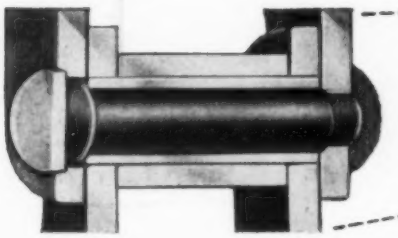
4715 W. Greenfield Ave., Milwaukee 1, Wis.

Roller Chains • Leaf Chains • PlateTop Chains • Double Pitch Roller Chains • Sprockets • Couplings

the PLUS values in...

REX® CHABELCO® CHAINS

Where you need power drive chains to handle heavy loads at slow to moderate speeds, the plus quality in Rex Chabelco Steel Chains can put *plus* value into your equipment. These chains, in their service range, are your most economical choice ...will transmit more horsepower per dollar. They have the rugged strength... the designed-in dependability...that resist heavy shock loads and tough operating conditions. Here are two important reasons why:



IN PLANNED TOLERANCES

The press fit of pins and bushing in chain side plates is an important factor in chain life...in its ability to resist shock loads. In Rex Chabelco Chains, these tolerances are "designed in" and held through precisely controlled manufacturing techniques. Even the pins and rivets of these chains have highly finished surfaces to provide the required precise fits. You get the maximum bearing area for longest possible chain life.

IN POSITIVE LOCKS

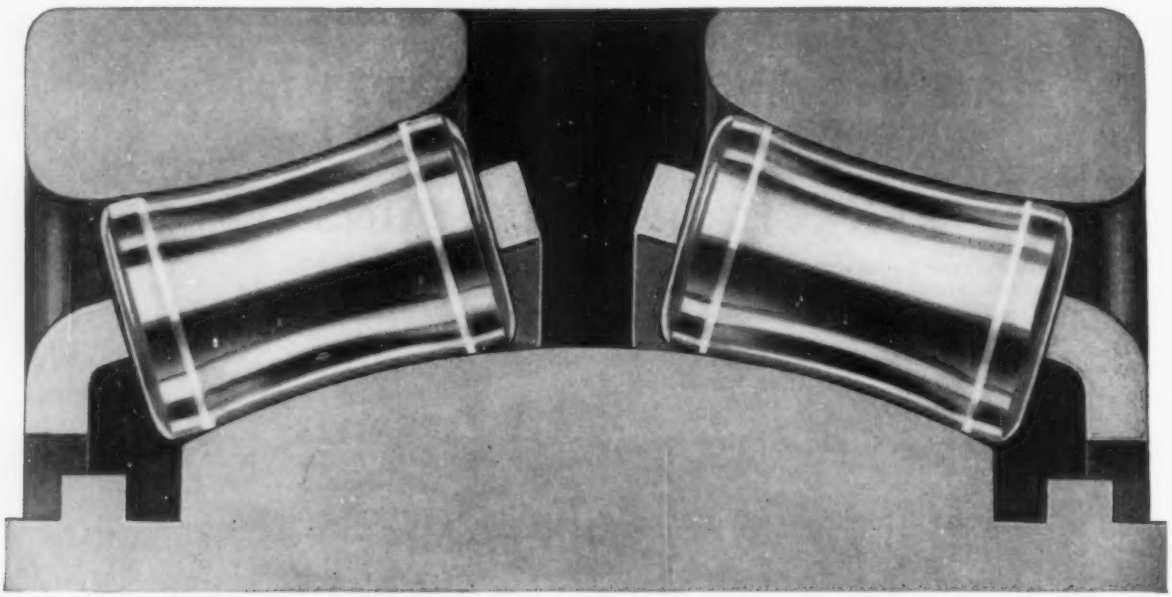
Turning of the chain pins in the side plates causes excessive wear in the side plate hole in any chain...destroys chain pitch...results in early chain failure. In Rex Chabelco, pins have a special-shaped milled flat on the end which fits into a special hole in the side plate. This positive lock, plus the controlled press fits, prevents any turning of the pin...assures longest chain life. For the story on Rex Chabelco Chains, send for your copy of Bulletin No. 56-57.

turn page

CHAIN BELT

4715 W. Greenfield Ave., Milwaukee 1, Wis.

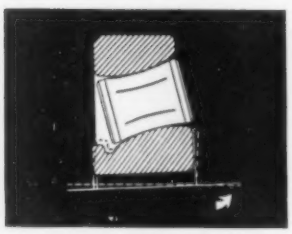
Chabelco Chains • Cast Chains • TableTop Chains • Drop Forged Chains • Sprockets • Set Collars • Elevator Buckets



the PLUS *values in* SHAFER® BEARINGS

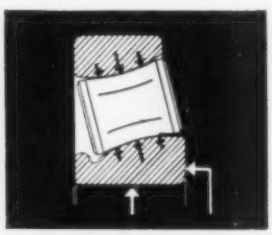
Combine the low-rolling friction of a ball...the high load-carrying capacity of a roller...and you have the *plus* advantages in Shafer Self-Aligning Roller Bearings. These bearings maintain their high load-carrying capacity under shock loads...continuous heavy-duty loads under misalignments.

Specifying Shafer puts an important *plus* in better service...longer life for your customers. Remember, a Shafer Bearing will deliver its rated load capacity for *five years or more*. Compare this with other bearings with an average life rating of one year or less. Here's why!



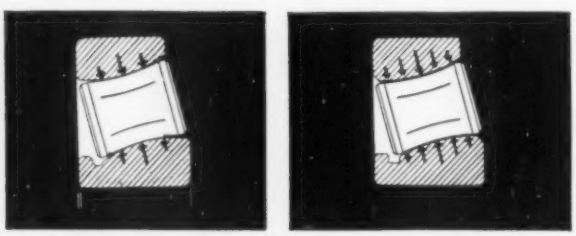
SHAFT DEFLECTION

Shafer design permits unrestricted compensation for shaft deflections, misalignment, shock loads...permits a total of 3° of misalignment.



RADIAL, THRUST OR COMBINED LOADS

Shafer free-roller design handles radial, thrust or combined loads without loss of bearing capacity. There is no roller end wear...no need for guide flange at roller end.



Under Normal Load **Under Heavy Load**

SHOCK RESISTANCE

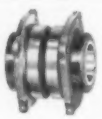
The high inherent elasticity of the bearing-quality alloy steel rollers and raceways provides maximum resistance to shock loads. The elasticity of these rollers and raceways permits compression under load and shocks... the contact area increases to fit the bearing area to the load requirement.

Pillow Blocks

Flange Units

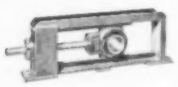
Flange Cartridge Units

Cartridge Units



Duplex Units

Take-Up Units



Take-Up and Frame Units

CHAIN BELT

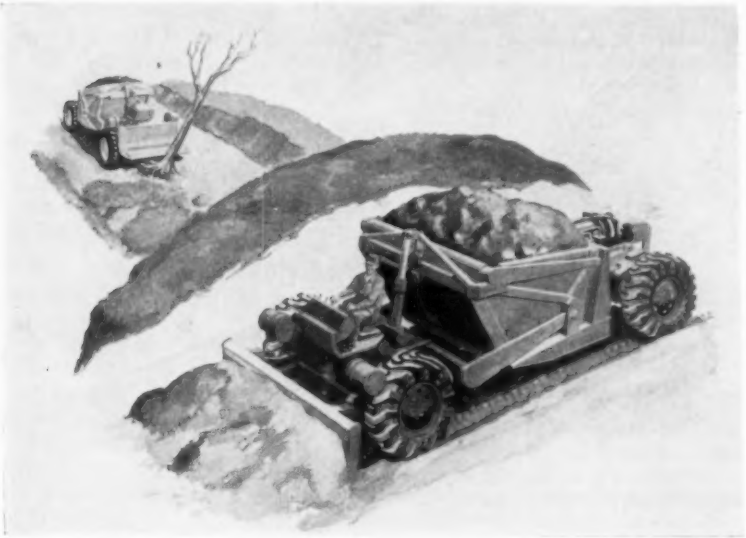
4715 W. Greenfield Ave., Milwaukee 1, Wis.

For complete data on the *plus* advantages of Shafer Bearings, write for your copy of Bulletin No. 55.

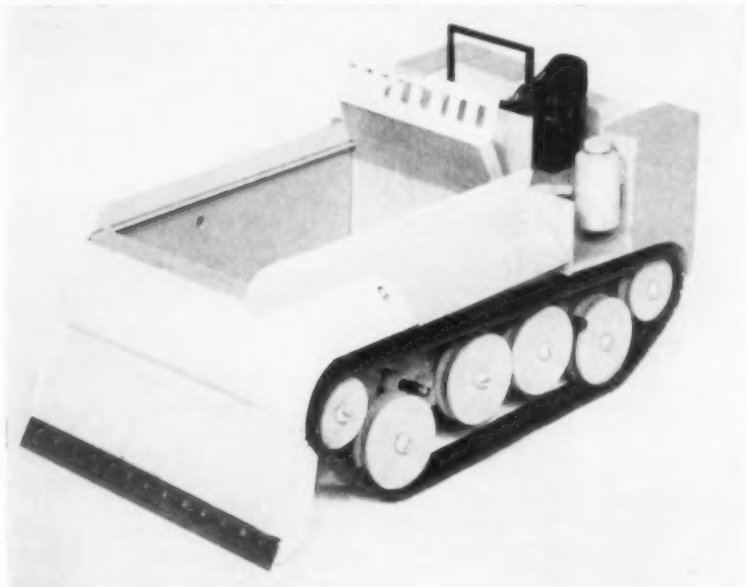
More Power Per Pound in New Army Tractors

FORT BELVOIR, VA.—The BAT (Ballastable All-purpose Tractor) one of two special tractors developed by the Army Engineer Research and Development Laboratories here is designed with easily detachable front and rear sections allowing for a variety of body forms.

This is possible with the mechanical drive at the rear wheels supplemented by an electrical assist on the front drive system. Body types include: cargo and shop units, liquid transporters, earth augers, and perhaps cranes.



You name it . . .
Bulldozer, grader, scraper, prime mover—this Army Engineer-designed tractor will do it all. Known as the BAT (Ballastable All-purpose Tractor), it will weigh less than 16,000 lb for airborne requirements and can be ballasted with 32,000 lb. of dirt.



Army crawler tractor . . .
still in the design stage at Army Engineer R&D Laboratories at Fort Belvoir will weigh less than 16,000 lb and when ballasted will weigh 35,000 lb. Considered more mobile than the BAT, it features a front end loading compartment

With dirt as ballast, the BAT is a dozer and prime mover with twice the work capacity of conventional machines the same size. Power unloader makes it a conventional motorized scraper. It can also operate as a dump truck or loader, as a rough grader with a scraper blade or dozer blade, and can be used as a truck transport. When detached, BAT's sections can be carried by helicopter.

The second of the new tractors, (lower photo) is an all-purpose crawler, and is currently in the design stage. The ballast compartment of this unit is in the front, making it usuable for transport of loads such as shop units, servicing and utility equipment. Ballast cargo is power loaded and unloaded.

Both tractors are light enough for air-transport, and reportedly require less maintenance than the various conventional vehicles it can duplicate. BAT is being fabricated by Barnes-Reinecke, Inc., Chicago. The second tractor is being designed by International Harvester, Melrose Park, Ill.

Hot Water Key to Supersonic Wind Tunnel

PARIS—Continental aircraft manufacturers have worked out the technical details for a large Mach 3 wind tunnel based on a new concept. Sponsors of the project, the Association Internationale des Constructeurs de Matériel Aéronautique (AICMA), say their design costs two-thirds less to build than a conventional closed-circuit tunnel and has the further advantage of being suitable for jet and missile engine combustion tests.

Key to the new concept is hot water, stored at 536 F and 924 psi in large accumulators. Fed to injection nozzles in the wind tunnel's intake chamber, the water vaporizes and creates a supersonic gust.

AICMA hopes to have a $13,000,000 facility with a 10-by-10-ft. throat operating by 1961. An exact 1:3.5 scale model of the proposed AICMA wind tunnel is now being built at St. Cyr in France. The pilot tunnel, with a 33 in. throat, should be ready for energy-system tests late this fall.

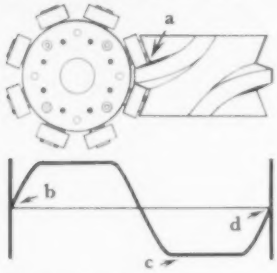
(Advertisement)

DESIGN CONSIDERATIONS

Critical Points in Acceleration Characteristics of Indexing Devices

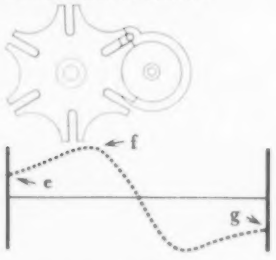
Maximum speeds of production machines are frequently affected by performance limitations of their indexing mechanisms. The efficiency of the indexing mechanism, itself, is dependent upon the amount of shock, vibration and other dynamic forces involved in the starting, stopping and rate of change from maximum acceleration to maximum deceleration.

FIG. 1 · · FERGUSON DRIVE



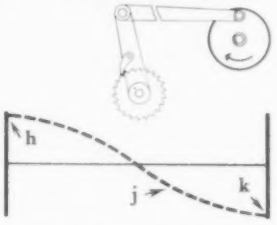
The acceleration curves of such mechanisms provide a graphic means of evaluating and comparing dynamic conditions that affect the performance of the indexing device and the machine. The Ferguson Drive in Fig. 1 is a cam indexing mechanism employing preloaded bearing followers rolling along a tapered cam rib. Two followers are in contact with the rib at all times (a) maintaining a zero backlash condition and an accuracy of .001″ without auxiliary locating devices. This Drive features a modified trapezoid acceleration characteristic . . . a combined cycloidal and gravity curve. The Ferguson Drive has an initial force of zero (b) and a smooth, sinusoidal increase. Its maximum acceleration value (c) is very low and the change through maximum deceleration to zero (d) is gradual. These smooth indexing characteristics of the Ferguson Drive permit operation of production machinery at speeds as high as 2,000 RPM, if necessary, with a minimum of 8,000 hours operation while maintaining extreme precision and zero backlash.

FIG. 2 · · GENEVA DRIVE



The six-stop geneva drive shown in Fig. 2 is representative of the geneva family in that its dynamic forces are instantaneously applied and the initial acceleration force is fairly high (e) with an even higher maximum acceleration (f). The change to maximum deceleration is gradual but there is an almost instantaneous stop (g). When operated at high speeds, geneva drives wear out quickly and cause heavy vibrations that seriously affect the life of the machine and product quality.

FIG. 3 · · RATCHET & CRANK



The rachet and crank has a distorted cosine acceleration curve (a true cosine curve is illustrated in Fig. 3) with an extremely high initial acceleration (h). The descent to maximum deceleration (j) is gradual but, as with the geneva drive, stopping is instantaneous (k). Even with auxiliary braking action, overtravel is extreme and accuracy is very poor. Rachet and crank devices have very limited use in modern production machines.

FIG. 4 · ·

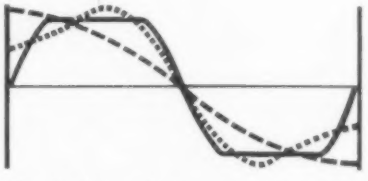


Fig. 4 shows the curves of the three mechanisms on the same diagram. Note that only the Ferguson Drive has an initial force of zero and the lowest maximum acceleration value combined with a gradual change to maximum deceleration. *This is why the Ferguson Drive does what no other indexing device can do!*

• SEND FOR CATALOG

Complete information about the Ferguson Drive is available in the form of an easy-to-use catalog containing load ratings and dimensions of many standard units, drawings and installation photos. There is a copy for every design engineer . . . for your copy write: **Ferguson Machine Corp., 7818 Maplewood Industrial Court, St. Louis 17, Missouri.**

AEC Outlines

GENEVA, SWITZERLAND—The number of industrial plants in the US using radioisotopes has increased by three times since 1953 with estimated cost savings rising from $100 million in 1953 to $500 million in 1957, according to Dr. F. Libby, Commissioner of the US Atomic Energy Commission.

Addressing the Conference here on the Peaceful Uses of Atomic Energy, Commissioner Libby added that a study of these cost savings now underway by the National Industrial Conference Board points to an impending total $1 billion annually—exclusive of the benefits to medicine and agriculture.

"Much of the economic growth and increased use results from the extension of conventional radioisotopes techniques, such as industrial radiography, thickness gaging and oil well logging. R & D is pointing to additional applications," Libby said.

"For example, industry has many uses for soft x-ray sources, but suitable gamma-emitting isotopes are not usually available. Multicurie size x-ray sources excited by beta rays are now being developed. Combined with recent development of image intensifiers, these sources make low energy isotopic radiography promising; combined with discriminating detectors, such as proportional counters, they may provide a rapid method of chemical analysis by selective or characteristic x-ray absorption. Use of several energies of x-rays excited by beta ray emitters permits quantitative measurement of different elements in a mixture. These sources also would offer advantages of long-time stability to thickness gages, long-time stability of such x-ray sources and for precision measurement of density, fluid detection, phase change and other applications in low density materials.

A basically new system is being developed for monitoring the concentration of toxic gases in the atmosphere by radioisotope exchange technique. Also, this system is being studied for other toxic materials.

Libby also said that one untapped but important industrial area is process control through radiometric analysis of diverted minute fractions of a process stream, and also in ionic analysis and control of aqueous solutions. Neutron activation analysis, al-

Isotope Uses

ready based on batch processes, is being adapted to production-line process control. This could find wide use as the beta thickness gage.

Libby said that most of today's uses of isotopes could have been made 20 years ago with the cyclotron. But the chain-reacting pile and fission reaction have made certain isotopes much cheaper and more abundant. Libby said, "Anyone with familiarity with technical matters and with isotopes can think of at least one new use every five minutes."

Libby also touched on the many uses still to be made of radiation energy, particularly the formation of new molecular bonds in materials presently impossible to obtain by chemical or physical methods.

Nuclear Power Costlier Than They Thought

NEW YORK—Rising reactor costs are putting a damper on many a country's ambitious plans for nuclear power. As American builders have also discovered to their sorrow (*PE —April 14, p. 52*), the first estimate is little more than a downpayment. The actual cost may turn out to be twice as great.

Reporting at the Geneva Conference on Peaceful Uses of Atomic Energy, Gustav Cederwall of Sweden noted, for instance, that his country had to restrict its nuclear reactor program because of rising costs and, instead of the several units originally planned, is now building only one—to provide heat for Stockholm buildings. In India, an ambitious program is planned—but not yet financed. Here, however, the cost of conventional fuels and plants is so high that nuclear power may actually save money. In Britain, rising reactor costs have not yet led to cancellation of previous plans, but rather to a stretch-out. Units expected to be in service by 1965 may not be completed until 1966 or later.

Nevertheless, reactors are being planned or built in almost every country in the world—from Poland all the way around to Japan, and many represent new types from which useful data can be expected.

WHAT CAN YOU DO WITH THIS FLEXIBLE, DURABLE METAL-MESH FABRIC?

Metal-mesh fabric—flexible, durable and with open mesh—has been accepted for years as a basic material for the fabrication of woven wire conveyor belts. Recently, though, resourceful design and production men have been finding new uses for this versatile woven wire construction. For example, slings for materials handling, protective curtains for forging operations, containing curtains for heat treating operations, tread reinforcements for modern high speed tanks, and even such domestic articles as doormats, fireplace screens and flexible room dividers.

Here are the important physical characteristics of metal-mesh fabric. How can you use them in your designing or production operations?

FLEXIBILITY—spiraled wire construction gives complete one-direction flexibility. You can coil it, draw it up on itself as a curtain or take it around corners.

OPEN MESH—Mesh size can be varied from 1/64" to 2½" or larger to provide for the passage of air, liquids, light or gases, but retain solid matter or particles.

DURABILITY—this fabric is of all-metal construction and can be produced in any metal or alloy, thus can be made resistant to heat, cold, corrosion, erosion or damage from impact or shock.

VARIETY—metal-mesh fabric can be woven to any length or width and in any of nine basic patterns. Further, any number of special side, surface or end attachments can be fitted to it.

WANT A SAMPLE?

Simply tell us what you have in mind as a possible use for metal-mesh fabric and we'll make up a sample section for your inspection and testing. Our own Field Engineer in your territory will deliver your sample to you personally and discuss your application with you.

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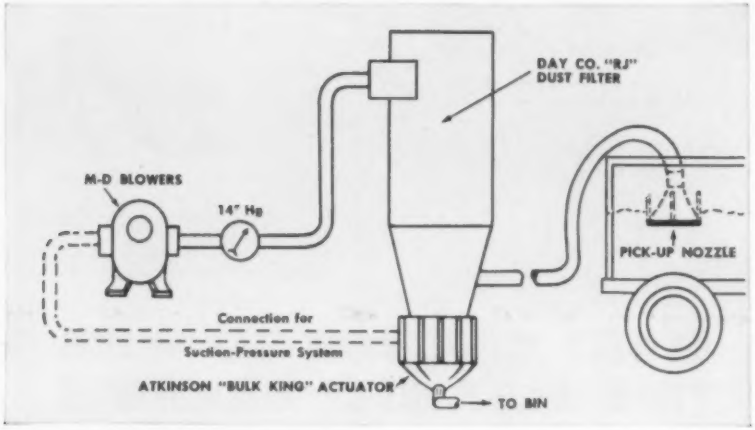
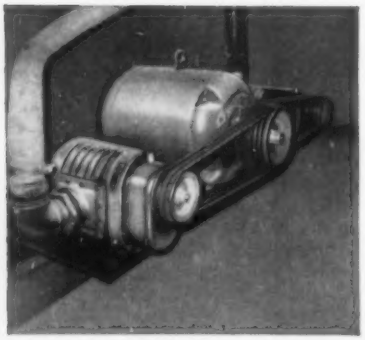
OFFICES IN PRINCIPAL INDUSTRIAL CITIES

NEW VACUUM METHOD
Using M-D 3-Lobe Blowers Unloads 1,200 Bu. of Wheat Per Hour





Two Model 5511 M-D Blowers operating in parallel furnish 1,600 scfm, 14" Hg continuous vacuum

Atkinson Milling Co., Minneapolis, unloads 1,200 bushels of wheat per hour (that's 72,000 pounds!) from standard trailers with a new vacuum method using M-D 3-Lobe High Pressure Rotary Positive Blowers. The diagram shows the simplicity of the new system employing an Atkinson "Bulk King" Actuator, a Day Co. "R.J." Dust Filter and two M-D Blowers operating in parallel. Economies are: Only one operator needed . . . low installation cost—far less than for system of lifting and dumping trailer . . . lower shipping costs . . . elimination of dust and infestation.

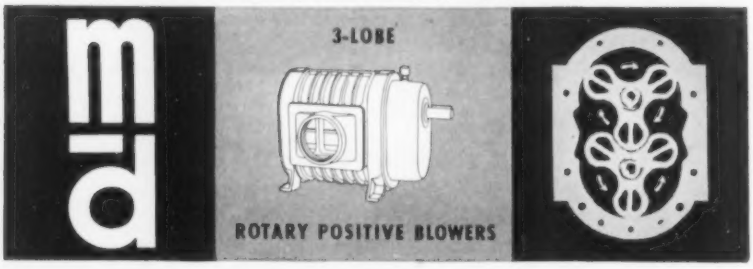
This system can easily be converted to a suction pressure system for handling flour, or granular material, by connecting the outlet side of the M-D Blowers to the rotary feeder valve, as indicated by the dotted line in the diagram above. A typical installation using two-stage M-D High-Pressure 3-Lobe Blowers, Models 5509 and 5507.5, can handle 1,700 pounds of flour per minute from trailer to storage bin. *Ask about other applications of low-cost, high pressure M-D Blowers!*

Specially designed suction nozzle enables one man to unload 40 foot trailer of wheat in 35 minutes

WRITE FOR NEW FOLDER GIVING PERFORMANCE DATA

M-D BLOWERS, INC. • 100 FOURTH STREET • RACINE, WIS. • MElrose 4-5521

A Subsidiary of Miehle-Goss-Dexter, Incorporated



Bits and Pieces

Supersonic flight chambers . . . which measures 18 ft high, 18 ft wide and 42 ft deep has a temperature range of from —100 to 1,200F with an ultimate altitude of 150,000 ft. Built by Tenney Engineering, Inc., Union, N. J. for McDonnell Aircraft.

Computing centers in Russia . . . may be linked into one system. Success in calculating tables that link different branches of the economy to determine raw materials, fuel, and metal needs of the entire USSR as well as increasing use of computer-controlled processes have been reported.

Europe's first beryllium plant . . . is being built by Imperial Chemical Industries Ltd. End products will include rods, tubes, plates and finished machine parts. Britain's Atomic Energy Authority will be the first customer, using the beryllium for fuel cans in an advanced gas-cooled reactor.

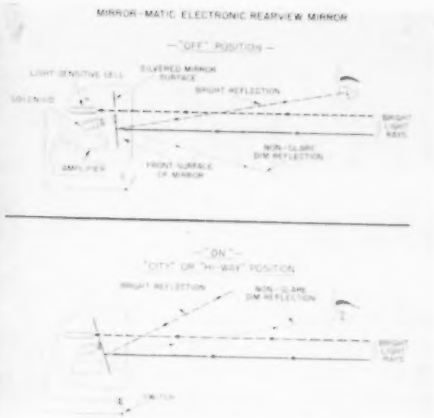
A closed-circuit TV camera . . . mounted vertically in a pressurized 1-ton capsule in the conning tower enabled crewmen of the A-sub Nautilus to view on a 21-in. monitor the distance of ice pack above them. The equipment was supplied by GE's Closed-circuit Television Dept., Syracuse.

F-104 Gets Infrared Fire Control System

AZUSA, CALIF.—Now in production and being installed on the Air Force F-104 Lockheed Starfighter is the only operational infrared fire control equipment in existence today, according to Aerojet-General. A heat-seeking device, it works basically on the principle used on air-to-air guided missiles.

Particularly adapted to night fighting capabilities, the infrared fire control system senses the position of an enemy aircraft and permits the F-104 pilot to close in on the target.

Some of the advantages claimed for the infrared systems: it cannot be jammed; it is less vulnerable to countermeasures; it's cheaper than other systems; is less complex; and gives better definition than radar.



Electronic rearview mirror . . . in 1959 Chrysler Corp. models is equipped with prism that can be activated by tiny photo-electric cell when the latter is subjected to intense light. The glare of headlights caught by the rearview mirror generates a current which activates an electromagnet to deflect the prism. New models will also have push-button heater controls that direct warm air anywhere in car through divided air ducts below the instrument panel and circular outlets above the instrument panel. Improved enameled exteriors is expected to reduce polishing frequency. New finishes incorporate 100% use of aluminum particles (compared to previous 60%-max) to achieve wider range of bright colors. Primer coat material is based on epoxy resins rather than alkyd resins to provide improved resistance to corrosion, chipping *(PE Sept. 18, '58, p 21).*

Soviets Claim Lead in Nuclear Power Race

GENEVA, SWITZERLAND—The USSR, based on evidence of a color film shown here during the Atoms-for-peace Conference, leads the world in development of nuclear power plants. Their film purportedly showed such a plant with 100,000-kw capacity. It used natural uranium, graphite as moderator and was water-cooled.

Dr. V. M. Emelyanov, head of the Soviet nuclear power program, said that five more nuclear power plants are being built in Russia with a planned 600,000-kw capacity.

The Shippingport, Pa. nuclear plant —largest in the US—is 60,000 kw. Largest plant on the agenda in the US is the 255,000-kw Consolidated Edison reactor plant at Indian Pt., N. Y., but it won't be ready until 1960. Britain's scheduled 500,000-kw plant won't be finished until 1962.

IF YOU'RE FAMILIAR WITH STANPAT
read column B only
IF YOU'RE UNFAMILIAR WITH STANPAT
read column A and B

COLUMN A

Thousands of firms save thousands of drafting hours with STANPAT

STANPAT—the remarkable tri-acetate that is pre-printed with your standard and repetitive blueprint items, easily transferred to your tracings by an adhesive back or front. Relieves time-consuming and tedious detail of re-drawing and re-lettering specification and revision boxes, standard symbols, sub-assemblies, components and cross-sections. Saves hundreds of expensive hours of drafting time and money, frees the engineer for concentration on more creative work.

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② **PLACE** the tri-acetate in position on the tracing.
③ **PRESS** into position, will not wrinkle or come off.

COLUMN B

NEW resin back STANPAT ELIMINATES GHOSTING, offers better adhesive qualities on specific drafting papers.

THE PROBLEM

Some of our longtime customers first called our attention to the "ghosting" problem. Certain tracing papers contain an oil which could be leeched out by the STANPAT adhesive (green back) causing a ghost.

THE SOLUTION

A new STANPAT was developed (red back), utilizing a resin base which did not disturb the oils and eliminates the ghost. However, for many specific drafting papers where there is no ghosting problem, the original (green back) STANPAT is still preferred.

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Send samples of your drawing paper and we will help you specify. Fill out coupon below:

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☐ Enclosed are samples of the drafting paper(s) I use (identify manufacturer). Please specify whether Rubber Base or Resin Base STANPAT is most compatible with these samples.
☐ Send literature AND samples of STANPAT.
☐ Please quote price on our enclosed sketches which we are considering to have pre-printed by STANPAT.

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DESIGN OF EXPERIMENTS

—blind spot for researchers

Shooting fish in a barrel may look easy. But without knowing where to place your shots, a lot of ammunition will be wasted —and you may not even get one hit. Statistics tell researchers where to place their shots in experiments involving many variables—and gives mathematical tools for tallying the score.

EDWARD R. SCHWARZ, *Professor of Textile Technology, MIT*

It's expected that a research worker with a PhD in the engineering sciences knows something about how to run an experiment. That's his job—test a system under varying conditions, see how it reacts and find the optimum combinations of variables which give most desirable results. It's assumed that experience and educational background has taught such researchers the most efficient testing procedures. But the startling fact is that it has not. Out of a group of 75 in one large laboratory—many of them PhDs—over 40 had never actually planned an experiment. Similar situations in other labs are not uncommon.

The average researcher is probably very clever about choosing the variables he will test, combining unlike elements, seeing hidden relationships, and explaining the mechanism of an unexpected result. But **between the clever idea and the clever explanation is some not-so-clever testing procedure.** Time is lost, money is wasted, and sometimes a valuable bit of information remains hidden, all because he doesn't know the techniques of experiment design.

At the Bottom: Poor Training

Much of the trouble can be traced to poor laboratory techniques at both preparatory school and college level. Usually the student performs only the "critical" experiment. This is reasonable; it saves time, effort, and needs only standard apparatus. But the student does not appreciate that such decisive experiments, answering "yes" or "no" to a question, result from many "preliminary" and "major" experiments made by competent people over a long period of time. He enters the lab to find that the required apparatus is set out on the table for him, along with a sheet or two of instructions and a log sheet for the record. The main factors are all determined in advance—he knows not how or why.

It is foolish to ask that the student do all planning and preliminary experimentation himself. Time is too short. And his experience and technical knowledge at this point in his training may be inadequate. But with **instruction in the design of experiments** he will learn to plan and analyze his tests as well as carry through the operations methodically.

Planning With Statistics

When testing a system where several variables have an effect on the result, a number of methods can be used to find the optimum combination of variables. The classical method suggests that one variable be measured while all others are held constant. This takes time and there is risk of missing hidden, essential information. Another method chooses values for each variable at random (and by intuition), scattering them about in a way which will expose major trends. Most of us are not lucky enough to hit the useful area this way; moreover, data of this sort are not readily analyzed mathematically.

With statistics, on the other hand, the analysis can be made systematically. Points scattered statistically yield tables of data which are easily reduced to a series of equations. Researchers can give a mathematically computed value for the amount of variation. Any clerk can be trained to make up the tables and prepare the equations for analysis on a computing machine. But **the experiment must be planned** and only a researcher with considerable technical knowledge and judgment can plan experiments or interpret results. Data which have not been scattered statistically cannot yield statistical information.

Industrial application of statistics is not new. It has been a tool of the quality control departments for many years. Even design of experiments by means of statistics is not new. But only recently has it found widespread application in industry.

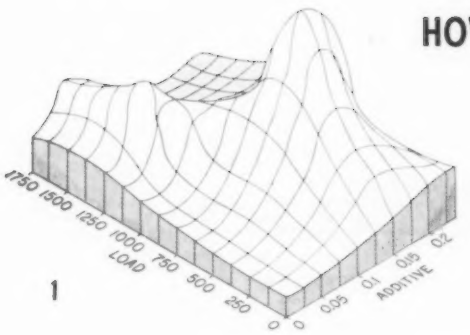
Sampling is Critical

The researcher must learn not only the mathematical mechanics of statistics, but the methods of sampling, testing, tabulating and plotting as well. Too often the sampling is not completely planned and is left to a subordinate who draws samples that are neither random nor representative of the desired population.

In some cases, measurements are dictated by existing laboratory equipment or laboratory skills and do not measure the desired quality. Or the data may represent the desired quality with the desired precision, but not be representative of the end use of the product. A manufacturer of fabric for neckties found that sales were declining. A check of the quality control department revealed they were **testing all yarn for tensile strength—apparently on the assumption that the majority of wearers were contemplating suicide by hanging.** How much better to determine the gravy resistance of the fabric—or its ability to lose wrinkles overnight!

In research, there is the choice between controlling certain variables, or studying their patterns of variation. The first is as dangerous as sitting on the safety valve of a steam boiler; the second may prove an amazing source of information. ■

HOW'S YOUR EXPERIMENTAL TECHNIQUE?



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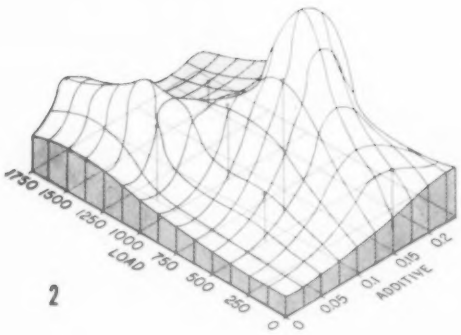

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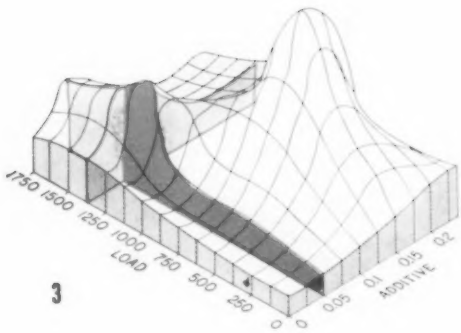

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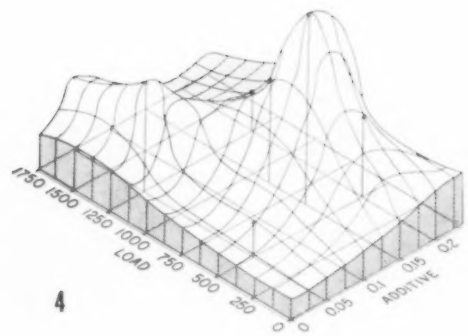


4

Three research engineers are given the same problem with the stipulation that time and money allow only a certain number of tests. Each is to solve it his own way.

THE PROBLEM.
An additive is being considered for use with a lubricating oil. Bearing life is expected to be dependent upon bearing load and amount of additive used. What is the optimum percent of additive and load for maximum bearing life?

THE ANSWER is shown above, plotted in 3-dimensional form. Maximum bearing life occurs at approximately 0.16% additive and 600 lb bearing load. Statisticians call this irregularly curved surface a "response surface."

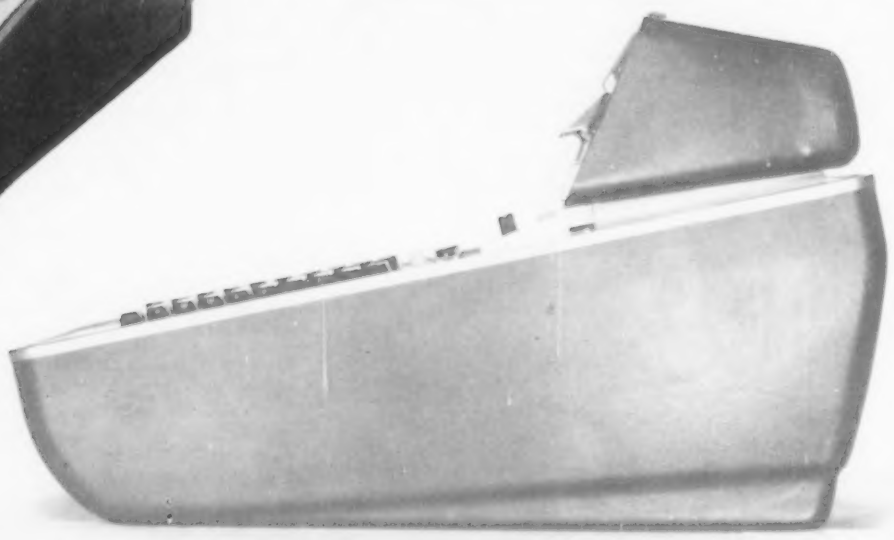
Engineer A chooses random combinations of additive and bearing load. He attempts to scatter points and thus cover most of the area of the response surface. According to his tests, the best combination is 0.125% additive and 600 lb load. This gives a figure for bearing life only 70% of the real maximum. The method is crude, he says, but with the limited number of tests allowed, it gives the best picture of the surface. His test points look like this. (Fig. 2)

Engineer B takes the classical approach. He holds load constant at 1350 lb and varies the amount of additive. With this load, he finds maximum bearing life occurs with 0.05% additive. He then tests this mixture of oil at various loads and finds that maximum bearing life can be had with a load of 1200 lb. But bearing life with this combination is only 65% of actual maximum. Results of his tests look like this. (Fig. 3)

Engineer C chooses his points in a pattern that allows the data to be analyzed statistically. The results of a few preliminary tests are fed to a computer, giving a series of polynominal equations roughly representing the response surface. Analysis of these data suggests that additional tests should be confined to smaller area between mixtures of 0.125 and 0.175% and loads of 500 and 1000 lb. His answer after a second set of tests: 0.15% additive and 625 lb load and life is 95% of real maximum. His data are scattered this way. (Fig. 4)

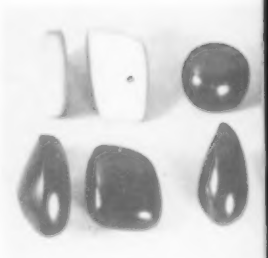
Design of experiments using statistical methods is applicable to problems with any number of variables. Although the analysis often requires a computer, most of the data can be prepared by a technician with only rudimentary mathematical skills. Pencil-and-paper math, although more laborious, is sometimes economical for small problems.

TRENDS in

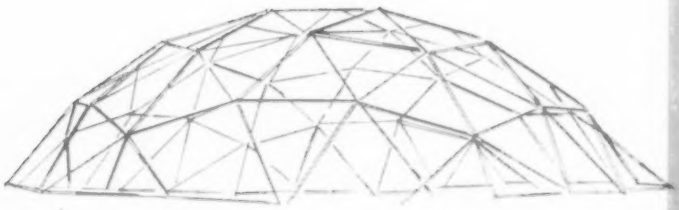


One product for **large-quantity** and another for **small-quantity** production have recently come out of the same design organization.

Placing perforated card for a particular airline flight in slot in reader (upper) head and punching dates, times, number of seats required and other details into keyboard section actuates centrally located data processor. Query is answered in seconds, even over thousands of miles of lines, and actual reservations are made as quickly. Designed for small-quantity production, housings are a vacuum-drawn copolymer; reading head's face plate is brushed stainless, and keyboard panel is a phenolic-coated laminate. Latter unit can be flush-mounted in counter-top if desired. The operation is simplified by using alternate bands of ivory and green to correlate information on perforated card with rows of lights and variously shaped and grouped push-buttons. Design credits: Laird Covey and Thomas Helms, industrial designers, Monroe, Conn.; J. L. Murphy and Stuart Harris of Teleregister Corp.



Decreased over-all height and broadened housing provide router with lower center of gravity—black cover and repeated, heavy horizontal lines emphasize it. Cantilevering replaces two legs of former model, increasing visibility. Router is light, illuminates work area and motor-cooling fan blows chips away. Handle shape fills operator's hands (important in heavy cutting and when lifting straight up) but still makes possible "finger-tip" sensitivity for delicate jobs. Recessed switch and interlock avoid accidental actuation. Depth adjustment is by vertical rule and graduated ring. Two models are available: 7/8 hp, 23,000 rpm; 1¼ hp, 27,000 rpm. Design credits: Laird Covey and Thomas Helms, industrial designers, Monroe, Conn.; James Godfrey and Kestutis Damijonitis of Stanley Electric Tools, Div Stanley Works.



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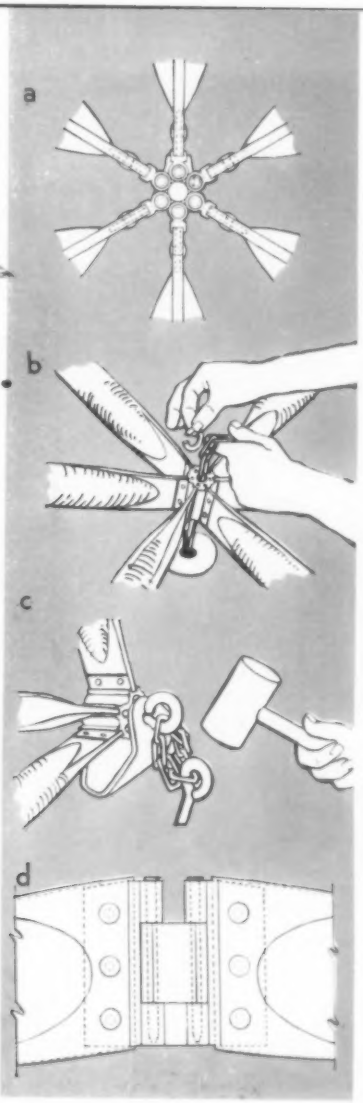
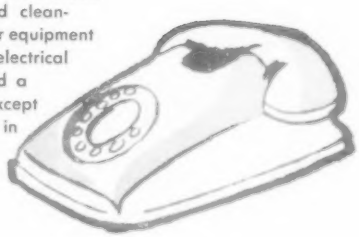


Telephone recently adopted for widespread use in the USSR is compact and clean-lined, like newest designs for similar equipment in US and western Europe. All electrical parts are sealed in what is called a "plug-in" unit in this country—except that in this case, unit is screwed in place, a change from soldering formerly employed.



Translucent, vinyl-clad nylon envelope is suspended from tubular aluminum-strut frame (at top, left) of this dome-shaped building. Said to provide shelter or storage for as little as $1.50 per sq. ft; erection takes 8 man-hours. Measures 57 ft dia, 16 ft high, and weighs 450 lb; can be relocated by crane or helicopter. Sketches illustrate (a) top strut assembly, (b) attachment of vinyl-clad cover to frame, (c) linkage between ground stakes and frame, (d) cross-secton of strut connector, showing stainless steel pins. Capitol Products Corp, Mechanicsburg, Penna.

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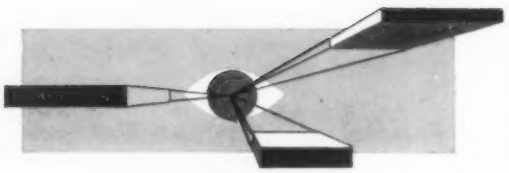


READERS DEBATE:

"the little man can't protect his

President George Washington awarded patent No. 1 to Samuel Hopkins of Philadelphia for "A discovery in the making of potash." From that day patent laws and theory have been the subject of much controversy. In PRODUCT ENGINEERING (July 28, p 26) Davidlee Von Ludwig insisted patents are "worthless paper unless the inventor can afford lawsuits to protect his rights. . . ." His article produced so great a reaction from readers that this week's "Points of View" is devoted to their comments.

Patent Waivers Unfair

Charles E. Brown, Dayton, Ohio, writes about the patent waiver: "The employer who requires execution of a patent waiver or agreement as a condition of employment is destroying whatever value such employe might have for that employer in terms of creative ability, goodwill, and cooperation. I have yet to meet an engineer or designer who looks upon the patent waiver as anything but one of those unpleasant arbitraries, like income tax returns, that one has to put up with in order to earn a living. The alert, intelligent, and creative individual who has not yet been ground into apathy realizes his own worth, and is capable of bringing interest and enthusiasm to his own affairs and to the affairs of any employer, group, or organization with which he may choose to associate himself.

"Such an individual is more than a passive machine that can be used to crank out routine predetermined work. He is able to make a substantial contribution to the welfare of his group or organization. The value of this man, I say, is destroyed or substantially reduced by the enforced execution of patent waivers and agreements. To him the patent waiver is little more than a slap in the face!"

Government Should Foot Legal Bill

". . . Von Ludwig's idea of making an issued patent the personal property of the inventor or his assignee is an excellent solution toward protecting the patent rights against infringement," **writes Willard H. Rice, consulting professional engineer, Berkeley Heights, NJ.** "Such suits should be brought before the criminal court and the burden of court expense borne by the Federal Government who issued the patent in the first place. The Patent Office should do its job, namely search for originality and issue a patent on that originality only. Make the Patent Office responsible for its decision by making that office a co-party to all legal results of the issued patent."

Attorney Norman S. Blodgett, Worcester, Mass., disagrees with this government-should-pay-concept, ". . . Mr. Von Ludwig seems disturbed because the government will not help him prosecute his patent rights after his patent is issued. Would he also expect the government to defend his suit against a trespass on his land? The situation is no different. I am certain that at any given time there is, somewhere in this country, a young, energetic patent attorney who will handle his case for him on a contingent basis, just as there are young

READERS DEBATE:

POINTS OF VIEW

patents" . . .

attorneys who will represent a plaintiff for a contingent fee in a suit against a negligent defendant who has a large and powerful insurance company in back of him."

But a New York City attorney Julius Cutler leaves little hope for an indigent inventor when dealing with patent attorneys. ". . . You really have to be a millionaire to do business with them, the fees they quote and get. If the inventor is a poor man, he might just as well bury, or forget his invention either before or after patent. Contingent fees are something I have never seen or heard of in this field–they all want it on the line."

Another patent attorney, Austin R. Miller, of Philadelphia, doesn't go this far, but does concede that ". . . the cost of patent trials and appeals is greatly increased by items which are beyond the control of counsel, including costs of court reporters, printers' charges, and other substantial items. The 'little man' would indeed be benefited by minimizing or eliminating such expenses. However, I sharply disagree with Mr. Von Ludwig's statement that, even with financial backing, the creator of an original idea can have no protection. The officially reported patent cases show repeatedly that individual inventors receive protection in the form of favorable judgments of the courts. Many patent cases have been fought to the finish without involving anything remotely comparable to the cost suggested by Mr. Von Ludwig."

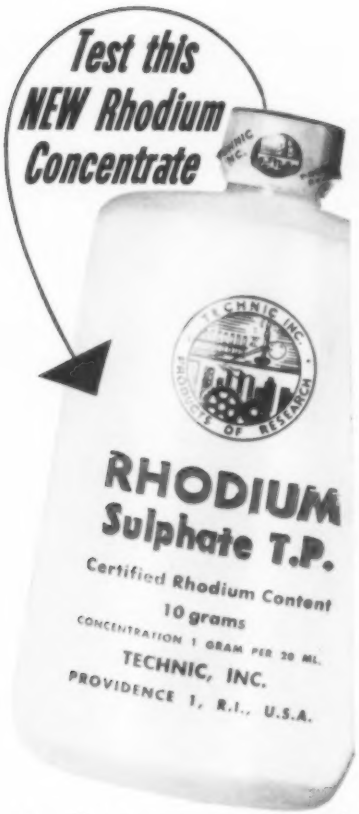
"The inventor's ignorance of patent law and the rights granted by patents is typically reflected in the Von Ludwig article," **says Philadelphia patent attorney Joseph Rossman. He calls attention to section 261 of the patent law which states, "Patents shall have the attributes of personal property . . . and the court shall award claimant damages adequate to compensate for infringement."** Like any other legal rights," **says Rossman,** "we have to go to court to enforce them."

Hints to Beat Patent Trouble

". . . Incentive is killed in this country by the stupidity of the US patent laws," **says Dudley B. Clark, director, Clark Electronic Laboratories, Palm Springs, Calif.** "Our past experience of 40 years in R & D may put some ideas into the heads of young inventors who have valuable ideas, but no money to speak of, and no large corporation to back them. If an idea is actually novel, and saleable, and does not infringe on any known patents, don't take it to 'large' corporation, or write letters about it. Start making and selling it in a small way, and increase sales as fast as possible. It will take large corporations a long time to get organized. You may file a US patent application, but always abandon it before it issues, and save yourself money, litigation, and tension.

"Another method available today, but only to the established concern, is the Armed Forces Research and Development contract. This sidesteps patent litigation expense, because the Government will own any patents that accrue. No one will get rich

(continued on next page)



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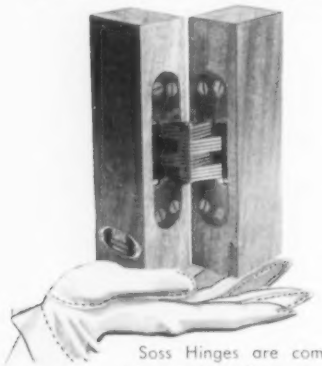

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READERS DEBATE:

"the little man can't protect his patents" . . .

out of the deal but you will not have any patent-protection expenses clamped on to you.

"If you have something positively sensational, that all the large corporations will break their neck to gimlet out of you, don't even file an application in the US Patent Office. Suppress it temporarily, except for a possible West Germany application. This will make any patent issued on it in this country invalid. When the US patent laws have been remodeled incentive-wise, and teeth put into them to protect you, then is time enough to release it here."

Improvements Are Necessary

"Without question our patent system has some shortcomings," says **Thomas E. Fisher, Cleveland patent attorney.** "This does not mean that we should, as Mr. Von Ludwig proposes, provide a totally new system because in some instances the patent system has worked hardships . . . most often the creative mind is an unusual mind. It is rare when attributes of an inventor and a good businessman are found in one person. Generally speaking, the attributes are the antithesis of one another. The greatest contributing factor to the failure of inventors to realize a reasonable return on a sound invention is that all too often they are poor businessmen, or an agreement is not reached because the inventor often rejects the norm.

"Any patent attorney can also cite countless examples of persons who have realized handsome returns on their inventions. Concededly, the sale of an invention is a difficult thing. Substantial development, tooling, and promotion investments are always required. For these reasons they are sold only after careful scrutiny by the purchaser. Nonetheless, fortunes, both large and small, are still made by inventors. A good invention, properly promoted, and offered at a reasonable price can always be sold. Like any other property offered for sale, if it has inherent defects or is overpriced, a buyer is hard to find.

"The patent system has been a vital factor in the growth of most American corporations. It would appear logical to adopt a system which has been used in some other countries where the government assumes the obligation of enforcing patent rights. Patent systems which utilize this philosophy have not been as successful as the American system in achieving the primary aim of any patent system: to foster and promote the useful arts."

CONGRESS STALLS . . .

Another session of Congress has come and gone without action in the patents field. Sen. Joseph C. O'Mahoney's Senate Subcommittee on Patents, Trademarks and Copyrights is continuing to issue scholarly reports on various aspects of the patent system, written by outside experts. But Congress paid little or no attention to writing new legislation. The perennial effort to overhaul patent fees never got out of the House Judiciary Committee.

O'Mahoney did make several proposals such as: creation of a single Court of Patent Appeals; the so-called "20-year bill," aimed at eliminating stalling tactics by some applicants by limiting the life of a patent to a maximum of 20 years from date of application or 17 years from date of issue—whichever is shorter; and a publication bill, aimed at cutting down on "defensive" patenting—obtaining a patent not for commercial use but as a precaution against another inventor's patenting the same idea.

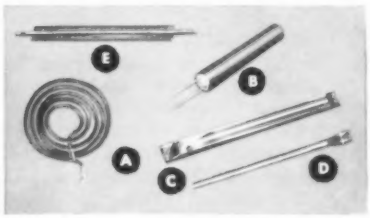
Probably all of these, and others, will be reintroduced in the next session of Congress. But following the significant increase finally made in the Patent Office budget about two years ago, Congress seems to have decided to rest a while before seriously considering any changes in the law.

Surface Heating Guide

How to choose electric heaters of the right type and size for your design

Here is condensed information to help you get the most economical electric heater for your surface heating design problem.

Two factors generally determine which type heater should be used for any particular surface-heating application. They are: the physical characteristics of your product, and the surface temperature required.



General Electric *tubular heaters* (a) can be formed to unusual shapes and may be "cast in metal" as part of your product during manufacture. They may also be located in grooves, inserted into drilled holes, immersed in liquids, wrapped tightly around the surface or spaced away.

G-E *cartridge heaters* (b) are ideal for "spot" heating of small areas. Short and compact, they can be easily inserted into drilled holes within the machine or surface.

For flat metallic surfaces, such as hot plates, platens and dies, *strip heaters* (c) may be clamped on or spaced away. General Electric *insertion heaters* (d) are ideal for heating hollow bolts for high-pressure steam-shell joints to prevent steam leakage.

For warming tables, and preheating plates, G-E *vane heaters* (e) may be clamped on or spaced away.

To figure the amount of heat required for your application:

1. Find the volume in cubic inches of the material in process.
2. Figure needed temperature rise in degrees F (subtract initial temperature of material from desired final temperature).
3. Find heat absorbed by material (Table 1 applies to all materials except those listed in Table 2). Values from Table 2 should be added or subtracted from values in Table 1 to correct it.
4. Determine the total surface area of the platen.
5. Using this area and the desired final temperature, check Table 3 to get heat losses of platen.
6. Add kilowatts computed in Step 3 to those computed in Step 5. You now know how much heat is required.

For complete information on sizes and ratings of General Electric heaters, send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

TABLE 1—HEAT ABSORPTION IN KILOWATTS OF MATERIAL IN PROCESS

Volume of Material in Process (cu. in.)	Temperature Rise in °F					
	50	100	150	200	250	300
1	.006	.012	.018	.024	.030	.036
5	.030	.060	.090	.120	.150	.180
25	.090	.180	.270	.360	.450	.540
100	.360	.720	1.08	1.44	1.80	2.16
500	1.80	3.60	5.40	7.20	9.00	10.8
1000	3.60	7.20	10.8	14.4	18.0	21.6

This table is based on a ten minute working cycle. If working cycle is other than 10 minutes use following formula to correct values: 10 divided by the number of minutes in the cycle times the kilowatts given above equals the kilowatts at the new cycle. Table 1 will apply for all materials except for those listed in Table 2. Apply correction factor if needed.

TABLE 2 CORRECTION FACTOR

Material in Process	Subtract or Add % as indicated to figure in Table 3
Aluminum	−30%
Dry Wood or Paper	−50%
Wet Wood or Paper	+20%
Glass	−40%
Rubber	−30%

TABLE 3*—PLATEN HEAT LOSSES IN KILOWATTS

Surface area of metal platens in sq. inches	Final temperature in degrees F of metal platens			
	100	200	300	400
100	.024	.080	.160	.280
250	.060	.200	.400	.700
500	.120	.400	.800	1.40
1000	.240	.800	1.60	2.80
2000	.480	1.60	3.20	5.60
3000	.720	2.40	4.80	8.40

*This table based on platens being completely uninsulated.

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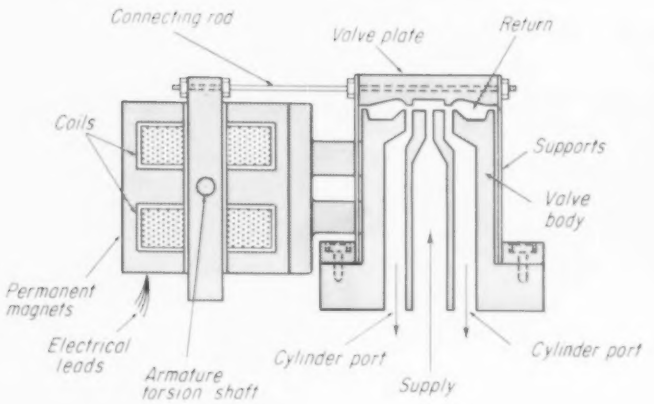
SIGNIFICANT COMPONENTS • MATERIALS • PROCESSES



Electrohydraulic valves . . .

have no metal-to-metal contact between porting plate and body and were designed primarily for use with this manufacturer's pumps and transmissions. Plate is moved to open position by torque motor. Returned to exact center (or "off") position automatically by torsion bar-action of motor shaft. Clearances and port-seal sizes can be varied to suit application and fluid handled. Flow rate is essentially a linear function of valve displacement, supplying high fluid-power gain with minimum movement. Specifications: flow rate is 4 gpm at 250-psi, 8 gpm at 1000-psi pressure drop across valve. Supply pressure, to 3000 psi. Torque motor has a mid-position force of 11-lb minimum; 5-w max power demand; stroke ±0.015 in. Weight, 4¼ lb; dimensions, 4¾ x 2¾ x 3 in. deep. Less than $55; delivery, 8-12 wk. **Oilgear Co, 1560 W Pierce St, Milwaukee 4.**

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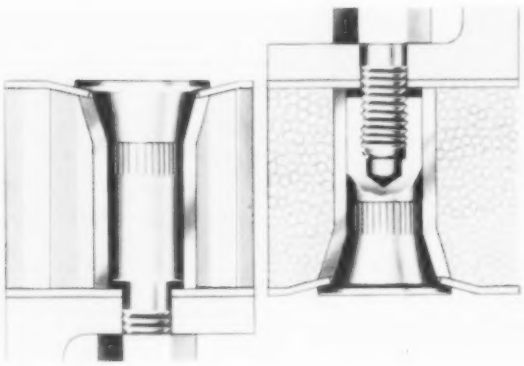

Structural fastener . . .

for sandwich panels is retained by splined interlock that also prevents rotation. Consists of pre-assembled body and expanding sleeve. Body section is available in many forms, including internal threaded, threaded stud, male rivet and through-bolt types. Flush applications with min dimple on both skins are achieved. No special tools or skills are required for installation. High column strength of fastener is said to prevent crushing of panels and max shear strength is achieved by distribution of loads to both skins. Fastener requires no filler to hold in panel. Available in a variety of styles and materials. Accommodates bolts from No. 6 to ¾-in. dia; rivets from ⅛ to ¾-in. dia; panels with core thickness of 0.355 in. min. Prices are comparable to structural fasteners now in use. At present, delivery is about 6 wk max on most sizes. **Deltron Co, 5224 Southern Ave, South Gate, Calif.**

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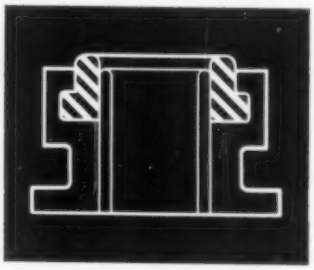

Fluid and gas sealing . . .

elements are composed of variously shaped metal shells with an elastomer member locked in place and having an O-ring-shaped projection. Made in 0.075 to 1.16 ID; various elastomers, metals and finishes available. Prices range from 45¢ to several dollars, depending on size, material and quantity. Delivery for most units is about 3 wk. **Intrex, 2310½ Michigan Ave, Santa Monica, Calif.**

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Low-static styrenes . . .

for injection molding are now available in two general-purpose formulations. Materials are said to eliminate practically all electrostatic fields that attract dust. Styrenes are formulated so molded surfaces are sufficiently conductive to allow most positive and negative charges to neutralize one another. Available in crystal and special colors. Priced 1¢ higher per lb than standard nonconductive styrenes for injection molding. **Plastics Div, Monsanto Chemical Co, Springfield, Mass.**

Circle 14, Reader Service Card

Nylon-impregnated paper . . .

for applications requiring wet strength and abrasion resistance is said not to be affected by acetone and many other chemicals. Tensile strength of 1-in. strip before pressing is 58 lb crosswise and 88 lb lengthwise. After pressing, tensile is 92 lb crosswise and 118 lb lengthwise. Available in widths up to 60 in. Introductory price is about 15¢ per sq ft. Delivery, 3 to 4 wk max. **Knowlton Bros, Watertown, NY.**

Circle 15, Reader Service Card

News about HYPALON®

Seals of HYPALON in heat exchanger are undamaged by 125° F. aqua regia fumes

J. Bishop & Co. Platinum Works, refiners of precious metals at Malvern, Pa., have installed a new shell-and-tube heat exchanger to condense aqua regia fumes for safe disposal. The exchanger contains 1,275 Pyrex tubes each ⅜ in. diameter and 10 ft. long. Water circulates through the tubes; the aqua regia fumes are on the shell side.

Nearly 4,000 plugs of HYPALON, resembling one-hole bottle stoppers, are used to seal the tubes in the tube sheets—one seal per tube at the top tube sheet, two at the bottom. The seals of HYPALON permit thermal expansion and contraction; they prevent intermingling of fumes and water and they withstand aqua regia fumes at 125° F. The seals of HYPALON have been used for over 13 months without a failure.

HYPALON is especially suited for service where conditions are extreme. In addition to chemical resistance, this newest Du Pont synthetic rubber is completely resistant to ozone and highly resistant to heat, abrasion, weathering and flex cracking. Seals, gaskets, tank linings are but a few applications. Send coupon for details.

Seals of HYPALON resist corrosive action of hot aqua regia. 3,825 seals are used in this heat exchanger.

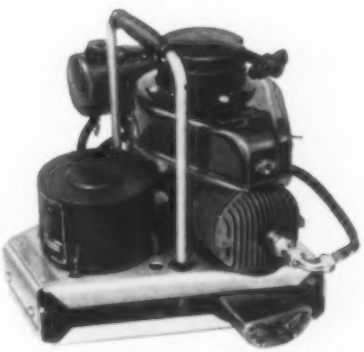
HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

Neoprene shock absorbers replace flywheel in flyweight generator

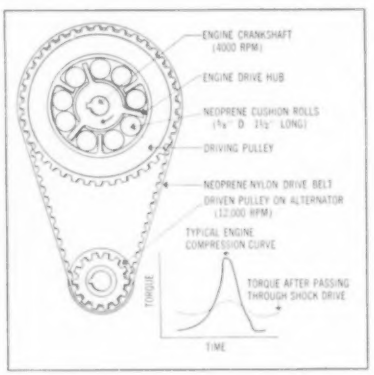
Neoprene was chosen by Lear, Inc., of Santa Monica, Calif., in the design of a portable 1500 watt engine-generator set that weighs only 35 lbs. It consists of a 1200 rpm permanent-magnet generator driven by a toothed belt from a 400 rpm one-cylinder two-cycle engine.

There is no flywheel. It was eliminated to save weight. Instead, Lear engineers have interposed nine cylindrical neoprene cushions in the power train between the engine crankshaft and the drive pulley (see drawing). The cushions iron out torque surges inherent in a one-cylinder engine.

Engine pulsations rapidly wore out drive belts in an early experimental model built without flywheel or cushions. Now, models with neoprene shock absorbers get good service life from drive belts. (Belts are neoprene reinforced with nylon, toothed to maintain a strict 3-to-1 ratio between generator and engine.)



Use of neoprene cushions instead of heavy flywheel cuts weight of this portable 1500 watt generator to 35 lbs.



Neoprene was chosen for both the belt and cushions because it is the only rubber that resists both oil and ozone at once. In addition, neoprene's resistance to heat, abrasion, chemicals, grease and weather gives you an outstanding combination of properties for designs that call for a durable resilient material. Please mail coupon for more information.

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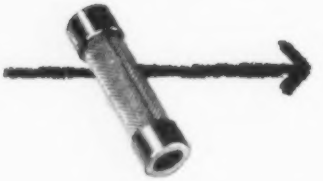
Special WIRE CLOTH PARTS



save money

save time

no production problems

no quality problems

Newark is the place to come for *your* fabricated wire cloth parts. We can save you time and money. We weave our own wire cloth so you have no quality control problem. We take care of production scheduling . . . you have no idle manpower or idle machine time worries. We will give you a better part at a lower cost.

For more data on this phase of NEWARK Service, send for our Wire Cloth Parts Catalog. If you have an individual problem and would like to have us recommend the best way to insert the wire cloth piece send us tentative drawings and specifications. If you are ready to order, we'll be glad to quote.

NEWARK *for* ACCURACY

Newark Wire Cloth COMPANY

351 Verona Avenue, Newark 4, New Jersey

SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .

Vibrating capacitor . . .

makes it possible for ac circuitry to measure currents as small as 10^{-16} amp. Unit's reed vibrates at frequency of applied voltage, producing a signal which may be amplified and measured by any amplifier. Contact potential that is characteristic of this type of equipment is minimized, and accompanying drift is never more than ± 0.2 millivolt per day, noncumulative. Dimensions are $\frac{33}{64}$ x 2.313 x 1.562 in. Price: $120-192, depending on quantity. **Stevens-Arnold, Inc, 7 Elkins St, S Boston 27.**

Circle 16, Reader Service Card

Self-locking inserts . . .

press into drilled holes, eliminating threading in thin and heavy materials. One-piece, all-metal insert, threaded or plain bore, with resilient segments, provides a shock- and vibration-resistant spring grip for screws, pins, shafts and similar components. Acts as a brake for cylindrical, axial and slide movements. Offered in a range of sizes and styles. **J B Plevyak Co, 19 Jefferson St, Newton, NJ.**

Circle 17, Reader Service Card

Cold-finished bar steel . . .

for wear-resistant parts needs no heat treatment during fabrication, in most cases. Min yield strength is 105,000

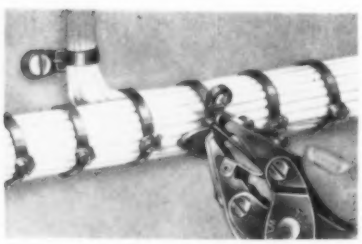
psi in round sizes 1½ in. dia and smaller; 100,000 psi for 1½ to 3 in.; 90,000 psi over 3 in. Min hardness of 248 Brinell in round sizes to 1½ in; 241 for larger sizes. Stresses that normally result in distortion after machining are minimized. Users are said to have reported exceptional tool life performance. **Jones & Laughlin Steel Corp, 3 Gateway Center, Pittsburgh 30.**

Circle 18, Reader Service Card

Heat-transfer fluid . . .

for use in ebullient cooling is said to give freeze protection both in engine and condensate-return line. Recommended for use in a 53% (by weight) solution in water for freeze protection down to about —45 F. Ebullient cooling is reported to result in uniform engine temperature, faster engine warmup, automatic circulation and temperature control of coolant, elimination of water pump, reduction of corrosion, increased lubricant life, and possibility of using cheaper, sulfur-bearing fuels. Circulation does not start until coolant reaches boiling point. Vapors rise through system, are collected and sent to a condenser which returns fluid to system. In most cases, conversion of conventionally cooled engines to ebullient cooling is possible. In ebullient cooling, temperature rise is 2 to 3° throughout system. **Organic Chemical Sales, Dow Chemical Co, Midland, Mich.**

Circle 19, Reader Service Card



Nylon tie speeds binding . . .

of bundles of wires or tubes. Installation is said to be made within about 5 sec. Tie is slipped under wire bundle, its knurled tip brought around and pulled through hub at opposite end. Installing tool cuts tie to proper length automatically and locks it in place permanently. Self-clinching tie is also available. It is the same as the tool-installed tie, but metal clinching teeth are included in its hub. Molded of nylon, cable tie weighs 1/35 oz and can support up to 30,000 times own weight. Accommodates wire bundles from ⅛ through 1¾ in. dia without damage to wire insulation. Available in white, red, blue, yellow, brown, green or black for color-coding. **Thomas & Betts Co, 36 Butler St, Elizabeth, NJ.**

Circle 20, Reader Service Card

Chace
Thermostatic Bimetal
ACTUATES ANOTHER PRECISION PRODUCT

THE LUMATROL LIGHT SENSITIVE SWITCH

A Product of Micro Balancing, Inc. Garden City Park, Long Island, N. Y.

The Lumatrol Model T is a tubeless photocontrol operated by a reliable thermostatic principle in conjunction with a large area photocell. This light turn-on control departs from convention in that it senses illumination from the zenith instead of from the north horizon. The Lumatrol's plastic dome diffuses and integrates the visible light (such as nearby commercial lighting) but does not transmit any ultra violet rays. Every component has reserve capacity and each control is equipped with a lightning arrester which permits its taking repeated lightning surges safely.

The Lumatrol consists of a large area photocell, an ambient temperature compensating bimetal thermostat and a bimetal operated snap switch, both elements being Chace Thermostatic Bimetal. At darkness the photocell has a very high impedence and practically no current passes through the resistor R1. As the light increases, resistance decreases, passing a current through R1, thus raising its temperature. The thermostat senses this temperature and closes its contacts, allowing resistor R2, wound around a bimetal element, to heat up. The bending action of the bimetal opens the switch.

The battle of such a delicate instrument against the forces of man and nature demands the utmost from such components as the thermostatic bimetal actuating elements. The faithful performance of this reliable control, day in and day out, even through its broad temperature range of —40° to +150°, is a fine tribute to the dependability of our precision product. It gives us added confidence that Chace's policy of manufacturing one product exclusively for almost a third of a century is a sound one.

When you design your new temperature actuated device, send for our 1958 edition of "Successful Applications of Chace Thermostatic Bimetal" containing many pages of valuable engineering data.

IT BENDS WITH THE HEAT

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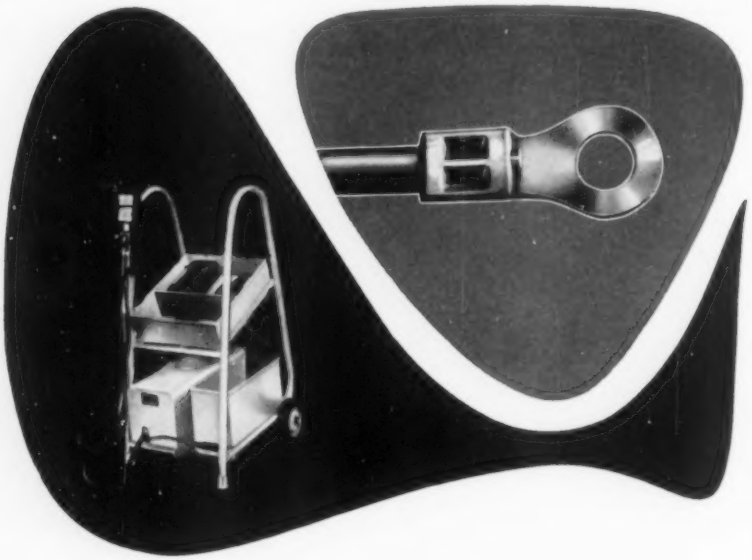
Thermostatic Bimetal
1607 BEARD AVE., DETROIT 9, MICH.

CIRCLE 78 READER SERVICE CARD

AMP® SOLISTRAND® Terminals

and DYNA-CRIMP® tools—



the right combination . . .

for electrical power generation and distribution

Take any assortment of conductors—solid, stranded or irregularly shaped. Add one A-MP Solistrand terminal. Bring them together in the proper A-MP Dyna-Crimp tool.

The result is always the same—an electrically-perfect, crimp-sure attachment at lower installed cost. Top performance even in adverse conditions.

And Solistrand needs no servicing. This is especially valuable where you have power machinery that must be left unmanned for long periods. Check these important Solistrand features:

- Exclusive double-indented crimp weds Solistrand barrel to conductors in a never-fail attachment.
- Crimping action of Dyna-Crimp tools forces combinations of conductors into one homogeneous mass. It does this at exactly the right pressure—no more, no less—for maximum conductivity and maximum strength with no weakening of conductors.
- Solistrand terminals are scientifically engineered in sizes to fit wires from No. 22 to 600 mcm.

And to serve you better, AMP maintains an international staff of field engineers capable of solving all your terminal problems.

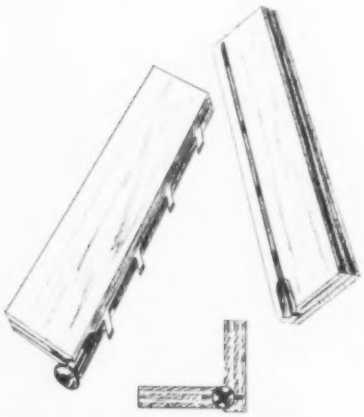
Write for our Solistrand terminal and connector catalog.

AMP INCORPORATED

General Offices: Harrisburg, Pennsylvania

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

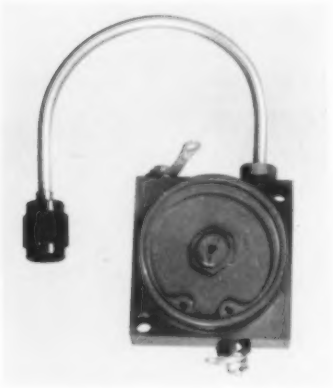
SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .



Fishbone panel connector . . .

locks into matching punched identations in fiber receiver insets, which are bonded with plywood, foam or honeycomb panels. Cap screw pulls connector and panels tight, in edge butt, miter joint or corner butt structure. **Dynacon Corp, 5475 Bow Mar Dr, Littleton, Colo.**

Circle 21, Reader Service Card



Miniature pressure switch . . .

is available in magnesium and aluminum. Weighs 1.5 oz and will operate up to 60 psig, within ±1 psig of setting. **Halax Corp, 17470 Shelburne Way, Los Gatos, Calif.**

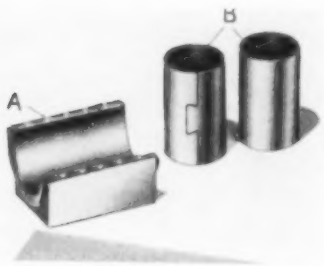
Circle 22, Reader Service Card

Semiconductor device . . .

is first of a series utilizing high-mobility intermetallic compounds, such as indium-antimonide and indium-arsenide, to achieve a broad range of controlled characteristics. Device produces a current output that is a function of the product of an input current and applied magnetic field. Has no moving parts. Measures ⅜ x ½ x 0.03

in. thick. Typical output for the unit, which uses a medium grade of electron mobility, at normal room temperature and no cooling, with input of 500 milliamp in a field of 10 kilogauss, exceeds 500 milliv. Cooling extends range. Frequency response, 10^{-10} to 10^{-12} sec. Available from stock. **Ohio Semiconductors, Inc, 1035 W Third Ave, Columbus 8, Ohio.**

Circle 23, Reader Service Card



Nonlubricated bearing . . . is reported to have run continuously without lubrication for over 1000 hr at PV values of 20,000 and in intermittent operation at PV values of 40,000. Bearings also perform well when lubricated with oil or almost any other fluid. With oil-wick lubrication, continuous duty at PV values of 60,000 without bearing wear is said to have been obtained. Construction consists of a steel-backed woven wire-mesh supporting matrix impregnated with a special formulation and given a surface treatment. Formulation extends beyond wire surface about 0.006 in. Can be provided in sheet or strip form in sizes to 6 x 12 in. and as standard rolled sleeve bearings. Bearings are capable of operating at temperatures of −400 to 550 F, but this decreases bearing life. Also available is flexible liner portion of bearing, which may be used for gaskets, seals and packings, especially where motion is involved. **Dixon Corp, Bristol, RI.**

Circle 24, Reader Service Card

Photocell control switch . . . is of modular plug-in design for use in counting, lighting controls, sorting, safety devices, measurement control, level control and automation. Based on solid-state light receptor with S-15 spectral response. Sensitivity is fully adjustable and unit operates reliably with a light intensity as low as 1 ft-c. Module includes DPDT relay with contacts conservatively rated 5 amp, 120 v ac. Mounts in any position. Unit plugs into an octal socket or an amphenol base with screw terminals. Operates from 110-v ac source with negligible current drain. Priced at $19.75. **Berkeley/Dynamics, 2831 7th St, Berkeley 2, Calif.**

Circle 25, Reader Service Card

"Choose from this wide range of Gast Air Compressors", says C. E. Bradley, Ass't. Sales Mgr. "Vacuum Pumps are also available in corresponding models."

Here's high performance . . . in a full line of

GAST rotary vane COMPRESSORS and VACUUM PUMPS

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Model 11 x 1740, total to 23 cfm.	0521, 1/3 hp. to 3.8 cfm.	3040, up to 24.2 cfm.	
	0321, 1/4 hp. to 2.2 cfm.	1550, up to 15.0 cfm.	2565, to 21.0 cfm.
10 x 1040, to 18 cfm.	0211, 1/6 hp. to 1.3 cfm.	0740, up to 5.6 cfm.	1065, to 8.3 cfm.
Single (In Hand) AD-440, to .6 cfm.	0406, 1/12 hp. to .6 cfm.	0440, up to 4.0 cfm.	0465, to 4.0 cfm.
		0240, up to 2.0 cfm.	4565, to 45.0 cfm.

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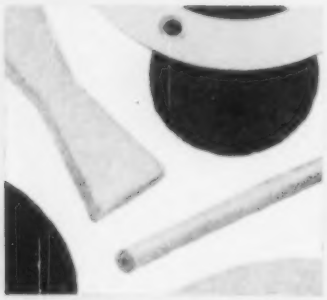

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SIGNIFICANT COMPONENTS
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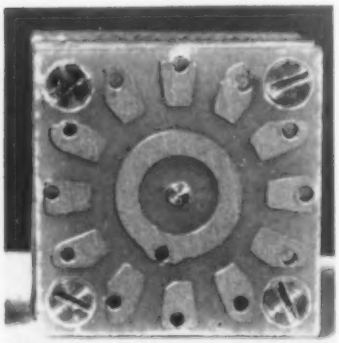
PROCESSES . . .



12-position switch . . . with positive interlock is capable of switching from dc to hundreds of megacycles. Contact points are gold-plated, with an ungrounded isolated center shaft, and flush mounted. Originally designed for switching subminiature ground or airborne radio frequency systems. **Avion Div, ACF Industries, Inc, 11 Park Pl, Paramus, NJ.**

Circle 26, Reader Service Card

Beryllium oxide shapes . . . hot-pressed and machined, have a melting point of 4658 F and retain good tensile and compressive strength, high hardness and high modulus of elasticity at temperatures to 3500 F. Material is said to have high thermal conductivity for a refractory material and excellent thermal shock resistance. Densities exceeding 95% theoretical can be obtained in hot-pressing operation. After cooling, blocks are machined into desired shapes. Blocks up to 6 x 12 in. dia are now being produced. Close tolerances are said to be possible. **Beryllium Corp, Reading, Penna.**

Circle 27, Reader Service Card

Electromagnetic counter . . . is operated by a balanced escapement mechanism set in jewelled bearings and energized by two electromagnets spaced around a common armature. Assembly has been tooled to fine limits. Wheels, cams, pinions and driving disk are molded from nylon. Figures are large and pat-

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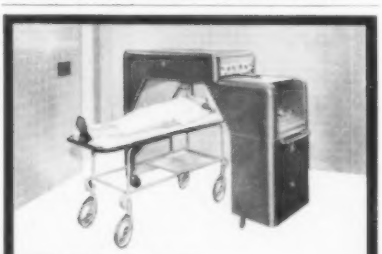

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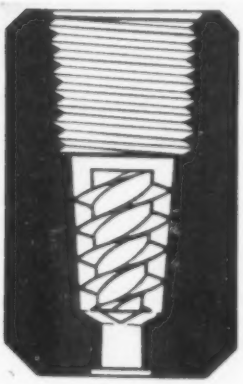
ented differential pinion gives figure alignment. Reset mechanism is heart-shaped cam type. Standard model is reset by depressing a small lever. Electric reset can be supplied. Counter operates on 24 or 48 v dc, 110 to 115 v ac, 60 cps or 200 to 250 v ac, 50 cps. Power consumption is 5 w. Operating speed is 25 counts per sec. Available for flush panel or base mounting. Price, FOB NY, is $25.20 for the dc unit; $27.60 for the ac model. Delivery, 6 to 8 wk. Made in England. **Intimex Corp, 8416 Georgia Ave, Silver Spring, Md.**

Circle 28, Reader Service Card



Atomizing nozzles . . . are for general service in operations where liquids in quantities to about 3 gpm are to be sprayed as fine mists. Nozzles produce fine, uniformly atomized, hollow-cone sprays. Sectional drawing shows internal construction of hexagonal nozzles. Fine-pitched spiral imparts rotating motion to liquid to make hollow-cone spray. Nozzles are stocked in bronze and stainless steel. At 50 psig supply pressure, nozzles pass from 8.5 to 145 gph. With water supplied at 150 psig, capacities cover a range of 15 to 250 gph. Nozzles produce fine sprays at pressures down to about 10 psig. **Schutte & Koerting, Cornwells Heights, Bucks County, Penna.**

Circle 29, Reader Service Card

Cold-cathode trigger tubes . . . replace relays, thyratrons and other devices in simplified circuits for military and industrial equipment. Designed to operate in ambient temperatures of −67 to 185 F, under extreme shock and vibration, tubes control to 500 amp with input currents of less than 20 microamp. Anode delay times are from 1.6 to 4 microsec, dependent upon type, with max variation of 0.4 microsec. Min trigger voltage for 2 microsec pulse is 230 v. Holdoff voltages range from 1000 to 3000 v. **CBS-Hytron Advertising Service, Parker St, Newburyport, Mass.**

Circle 30, Reader Service Card

56 details of stainless steel jet engine component brazed in three steps with no distortion or oxidation by Wall Colmonoy . . .

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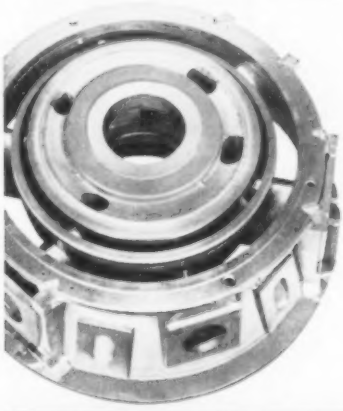

This jet engine diffuser casing is typical of the aircraft and missile parts being furnace brazed at Wall Colmonoy. As originators of Nicrobraz Process brazing, we have an unmatched background in the nickel-alloy brazing of stainless steel and superalloys. Our facilities also include vacuum furnaces for degassing and brazing titanium bearing alloys. Our three plants are ready and able to engineer and process your components. Call or write today.

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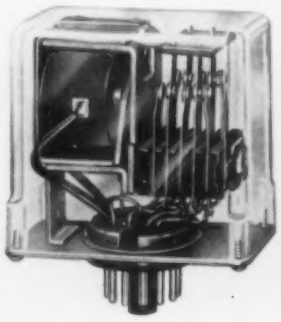


Relays . . .

have contacts with 10 amp current carrying capacity. Plug and socket combination limit ratings. DPDT on octal plugs and DPDT plus two normally-open contacts on 12-pin octal plugs are stock units. AC or dc operating coils. Typical DPDT unit is $1\frac{7}{16}$ x $2\frac{5}{8}$ x $2\frac{7}{16}$ in. high, excluding octal plug. Protected by plastic covers, and designed for plug-in. Life is said to be about 20 million operations. **Struthers-Dunn, Inc, Pitman, NJ.**

Circle 31, Reader Service Card

Teflon O-rings . . .

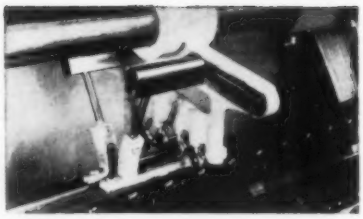
with exceptionally smooth surface and all raised flash eliminated is stable to 500 F. Not subject to extrusion or twisting under relative movement. For applications where O-rings fail because of heat, friction or chemical action. Available in over 140 sizes from stock. **Chicago Gasket Co, 1271 W North Ave, Chicago.**

Circle 32, Reader Service Card

220,000 psi locknuts . . .

are said to be from 10% to 33% lighter than even lightest 180,000 psi locknut. Nuts are cold formed from alloy steel and cadmium plated, with a supplementary molybdenum disulphide. Presently available in $\frac{1}{4}$-28, $\frac{5}{16}$-24, $\frac{3}{8}$-24, $\frac{7}{16}$-20 and $\frac{1}{2}$-20. **Elastic Stop Nut Corp of America, 2330 Vauxhall Rd, Union, NJ.**

Circle 33, Reader Service Card



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NEW LITERATURE

Energy for Man

HANS THIRRING. Published by Indiana University Press, Bloomington, Ind. 5½ x 8½, 409 pp. $6.95.

The subtitle of this book is "Windmills to Nuclear Power," and it means what it says. Practically every known source of energy and type of power plant is covered—and on a rather impartial basis. It devotes roughly equal amounts of space to internal-combustion engines, water and solar power, and atomic energy. On that basis, though, it is not possible to go too deeply into any of them, though the basic facts and formulas are well covered.

Prof. Thirring obviously knows his field—and particularly the atomic energy field. He is a leading Austrian physicist. As a matter of fact, a book entirely devoted to nuclear energy by him would be most welcome.

Prof. Thirring is, incidentally, no optimist.

On the future of direct conversion of solar energy to electric power, he says, "No considerable contribution to the energy system of the world can be expected" by means of thermoelectric units or solar batteries.

Of thermonuclear energy he says, "We cannot so far see any possibility of realizing power production from the heat of fusion reactions."

The book is clearly written, though in semi-textbook style. All names, for example, are in very heavy (and, for this reviewer, annoying) boldface. British units are used in most cases, and British and European developments emphasized. The latter is, if anything, an advantage, since a good deal of work not so familiar in this country receives attention.

Over-all, the book is a good review, and a valuable library addition. —ARC

Wescon–1958

Technical sessions at the 1958 Western Electric Show and Convention Aug 19-22 (1435 S. LaCienega Blvd, Los Angeles 35) included three entitled, "Human Factors in Engineering," "Engineering Writing and Speech," "Reliability and Quality Control." Papers presented on human factors included attempts to analyze human operators as quasi-linear mathematical elements in continuous-control, closed-loop systems.

The papers on engineering writing and speech included a description of a multipurpose, multi-audience speech kit, designed to aid presentation before a variety of groups of roughly the same spoken material. Another paper consisted of a two-hour course in technical-report writing.

In the session devoted to reliability, one paper compared various reliability tests. Another described a new engineering technique aimed at raising reliability, called the group-redundancy approach. A third paper discussed methods of integrating reliability procedures into systems analysis.

VACUUM ARC MELTING AND CASTING—Brochure, 12 pp. Discusses advantages of vacuum arc melting; melting techniques; equipment; testing and melting facilities; custom melting and castings. Contains chart of comparison of corrosion properties of zirconium, titanium, tantalum and Type 316 stainless steel. Oregon Metallurgical Corp, Albany, Ore.

Circle 1, Reader Service Card

PORCELAIN ENAMEL COATINGS—Reference file. Includes series of engineering data bulletin, reprints of informational literature about porcelain enamel and a copy of manual, "Porcelain Enamel and Ceramic Coatings." Covers general information, lists of porcelain enamel products, characteristics and properties, design data. Porcelain Enamel Institute, 1145 19th St NW, Washington 6, DC.

Circle 2, Reader Service Card

SEARCH FOR RELIABILITY—A 28-minute, 16mm color film for group showings. Narrated documentary is based on booklet on same subject, available for distribution as a take-away piece. Film discusses quality control and underscores importance of human factor. A W Scott, Advertising Dept, Standard Pressed Steel Co, Jenkintown, Penna.

Circle 3, Reader Service Card

WORK CENTER SYSTEM—Handbook, containing 15 sections, explains how basic system supplies such varied components as power, work position, stockroom setup, machines, lighting; and components to mount, house, fasten, connect and monitor electronics. Describes range of standard off-the-shelf components available to put proved methods and manufacturing practices into operation. Dept H, Alden Systems Co, Alden Research Center, Westboro, Mass.

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Publisher's Postscript...

a worth-while BONUS for you

Robert Abbott, assisted by Joseph Kelleher, and with the cooperation of the entire *Product Engineering* editorial staff, have just completed this year's Design Digest issue. Copies went into the mails last week to all subscribers. This is an extra issue of *Product Engineering* which rounds up in one place all the significant reference material of the past year, of special interest to design engineers.

It's an exclusive service to *Product Engineering* subscribers inaugurated in 1952, and published each year. It contains engineering information of long-range usefulness that developed during the year prior to publication. Most of it was selected and compacted from a wide assortment of engineering publications and technical-society and association papers.

To produce this issue, the editors go through all the issues of over 70 publications and review the papers presented at 34 engineering society and association meetings—a total of more than 14,000 separate pieces of information—to select significant material of special interest to product-design engineers. The result is a digest of current information to help you in the design, research and development of your engineered products.

The information is classified into 10 sections for easy reference. Not only is all the content cross-indexed, but the issue also contains an index by subject for the two previous Digests, to help you quickly locate the information you are seeking.

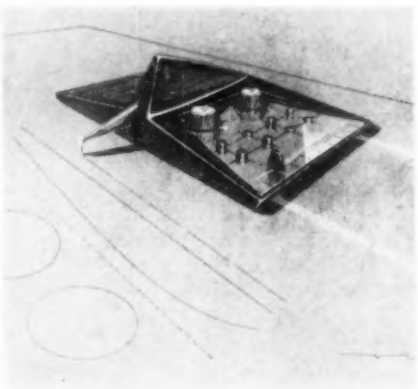
This year's issue will have a running head at the top of each page, indicating the name of the section—somewhat like a dictionary—for fast, easy reference. We have discontinued the thumb index because it is an extra operation that delays publication almost a month, and makes it difficult to get copies into all subscribers' hands at approximately the same time.

The many subscribers who have kept all the previous issues will find this a valuable addition to their store of information. The new subscriber will have the 3-year index in his copy, and can readily refer to former issues through his company or outside library. Like all previous issues, this one has a sewed binding and a flexible cover.

The Design Digest issue rounds out *Product Engineering*'s service to you—to keep you well informed on the significant engineering progress made in the field of product design, research and development. Bob Abbott and the staff have done an exceptionally fine job. —A. H.

74 For your information (personal)

For draftsmen of the future



Pencil-pushers will be obsolete in the drafting rooms of the future, predicts Parker Pen Co. Its engineers envision a self-propelled, electronically controlled drafting instrument that will "automatically execute all manner of geometric forms . . . without error, merely by setting the unit's calibrated dials and buttons." They've even given the unit a name: *Robo-draft*; and provided the rendering displayed here to show how it might look. Other ideas, dreamed up by Parker: a solar-powered pen, and one that makes it own ink by converting the nitrogen in the earth's atmosphere.

Chemical furs for milady?

Along about this time of year, many ladies get that "fur-away" look in their eyes; and, eyeing a shrinking bank account, many men begin wondering if one of the new synthetic furs might not do just as well—maybe better. After all, the new synthetic fibers are rot-proof, mothproof, water-resistant, stain-resistant.

The answer is that the fibers used in "fur" coats—generally acrylics like Orlon and Dynel—are all these things as they come from the supplier. But when fashioned into pelts, they begin to act—as well as look—like fur.

That is, make-believe mink will be no more washable than real mink, will probably spot if it gets wet, may become matted, and will need special compounds. This is because the fibers must be treated to resemble fur, and these treatments are not necessarily "permanent." ("Mink" must be given the striping that characterizes the natural pelt; "Persian Lamb," the well-known fiber curl; and so on.) Too, the fibers may be held in a backing which itself is sensitive to moisture or other destructive forces.

On the other hand, the synthetic furs are mothproof, and their price tags—about $2000 less than an "ordinary" mink, and comparably lower than other furs—make them a pretty good buy despite these limitations.

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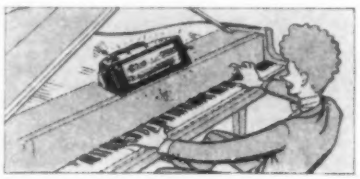
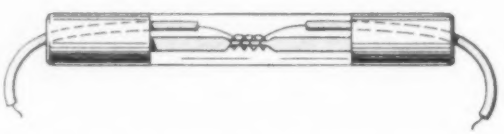
WHY DON'T THEY RESEARCH and DEVELOP...



. . . a projector–microfilm combination for musicians, particularly pianists and organists, so that their music could be projected on a screen. Each page of music could be reproduced in a single microfilm frame, and a button or pedal would permit the musician to advance or reverse the microfilm one frame at a time.—H. S. RENNE

. . . preset gas pumps? More people call for 5 or 10 gallons or $2 worth of gas than say, "Fill 'er up." The attendant could dial the quantity of gas, start the pump and then wipe the windshield or check the oil, confident that the pump will stop automatically. Also, how about a waterproof, thiefproof cash register to be placed out at the pump. How many trips back and forth to the office register before the attendant slows to a crawl and tempers start to rise?

—R. MYRAM



. . . a fuse with built-in heater coil? The main circuit would work normally—blowing out when the current reaches the design maximum—but the fuse could also be blown by a much lower current applied to the heater coil. Thus it would operate like a one-shot relay. Often in transistorized equipment, component failure requires shutdown, but bulky relays or extra amplifiers are needed to sense the low currents. —M. KUNZ

. . . automatic phone-dialing device for re-dialing busy numbers. Set to re-dial at regular intervals, a buzzer would sound to notify the caller when the line is free. —R. SCOTT

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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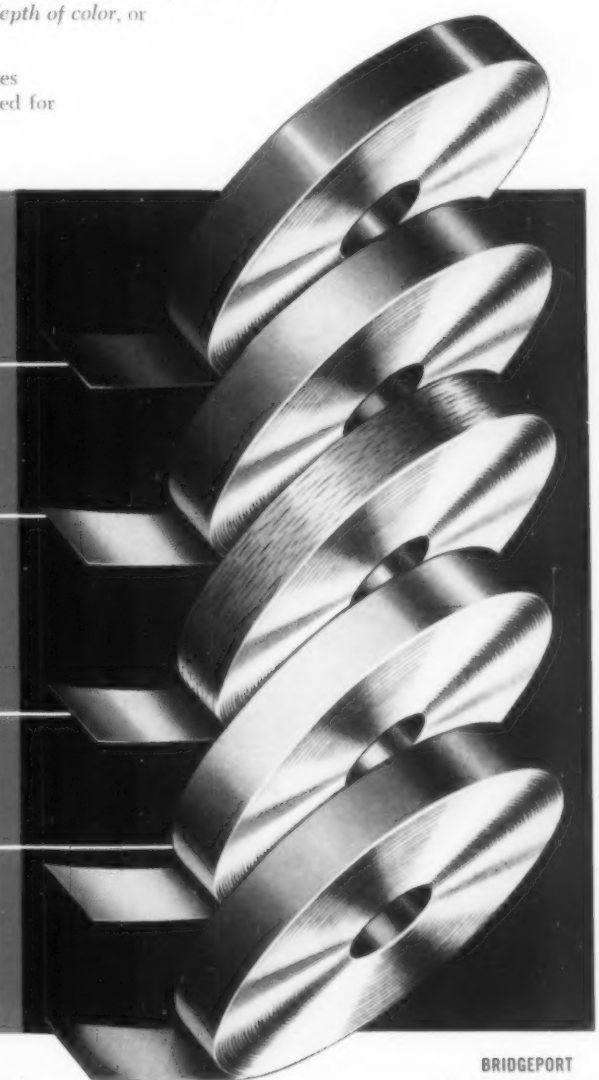

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